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PHARMACEUTICAL SOCIETY OF GREAT BRITAIN

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

VOLUME XXV.—1872.

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THE CHEMICAL NEWS.

VOLUME XXV.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 632.—FRIDAY, JANUARY 5, 1872.

CONTRIBUTIONS TO THE HISTORY OF ORCIN.

No. II. Chlorine- and Bromine-Substitution Compounds of the Orcins.[*]

By JOHN STENHOUSE, LL.D., F.R.S, &c.

Schunck,[†] and subsequently the author of this paper,[‡] many years ago studied the action of chlorine upon orcin, and obtained more or less crystalline products, contaminated with a brown resinous matter, from which, however, they did not succeed in separating the crystals in a state of purity. In the year 1864 De Luynes[||] obtained a crystalline substance by acting on orcin with a mixture of potassium chlorate and hydrochloric acid. De Luynes states it to be trichlororcine, $C_7H_5Cl_3O_2$, and in Kekulé's "Benzolderivate" the melting-point is given at 159°.

Chlororcin.

Pentachlororcin, $C_7H_3Cl_5O_2$.—This compound was obtained by the action of chlorine upon orcin when the former was kept in excess. Two methods of effecting this object were employed, the first by adding the orcin to chlorine hydrate, the other by the action of potassium chlorate and hydrochloric acid.

A pulpy mixture of the crystalline hydrate of chlorine and water was first prepared by passing a current of chlorine with occasional agitation through water, to which about one-third of crushed ice had been added, until a sufficient quantity of the hydrate was formed. On gradually adding a moderately strong aqueous solution of orcin, a purple colour was produced when the solution first came in contact with the chlorine hydrate, but disappeared immediately on agitation. The addition of the orcin was continued until nearly all the chlorine hydrate was decomposed. It was always advisable to leave a slight excess of the latter, as a purer product was then obtained, and also to have some crushed ice present in the mixture, to avoid decomposition and consequent loss of the hydrate by the heat produced during the reaction. The colourless or pale yellow solution, on standing, yielded a crystalline deposit of crude pentachlororcin.

After many trials, however, it was found that pentachlororcin could generally be more conveniently prepared in quantity by submitting orcin to the chlorinating action of a mixture of hydrochloric acid and potassium chlorate in the following manner:—Four parts of powdered potassium chlorate and a solution of two parts of orcin in seven parts of hydrochloric acid were added to thirty-five parts of hydrochloric acid, sp. gr. 1·17, placed in a large beaker, and kept cool by immersion in water; a small portion of the potassium chlorate was first added to the hydrochloric acid in the beaker; on pouring in some of the solution of orcin, the same evanescent purple colour made its appearance as when chlorine hydrate was used; the alternate addition of the chlorate and the orcin solution was continued in such a manner that there might always be an excess of chlorate, and that the contents of the beaker never became very hot. It was found necessary to use concentrated hydrochloric acid in this experiment, as otherwise the product was largely contaminated with a viscid oily compound. After twelve to twenty hours the crystalline chlororcin was collected and washed with a small quantity of water. Orcin treated with chlorine hydrate yields nearly twice its weight of crude chlororcine, but with potassium chlorate and hydrochloric acid about 150 per cent of its weight.

In order to purify the crude chlororcin obtained by either of the above-described methods, it was dissolved when dry in a considerable quantity of carbon disulphide (eight measures), filtered, and concentrated by distillation (to one-half). On being set aside for some time it usually crystallised out; but as it exhibits strongly the phenomenon of supersaturation, especially when impure, it was sometimes necessary to agitate or add a crystal of the substance. The solution then immediately deposited the chlororcine, and occasionally became hot enough to cause ebullition of the carbon disulphide. Two or three crystallisations rendered it quite pure. Pentachlororcin crystallises from carbon disulphide in large colourless prisms, melting at 120·5°. It is moderately soluble in bisulphide of carbon and benzol, and readily in ether. It dissolves somewhat in cold alcohol, and when boiled with it for some time undergoes a change which I have not as yet investigated—water throwing down an oil which only solidifies after having been exposed to the air for some days in a shallow vessel. The pentachlororcin is but very slightly soluble in water, to which, however, it communicates an exceedingly disagreeable and persistent bitter metallic flavour. When boiled with water it is decomposed, an oil and a crystalline solid passing over with the vapour. The oil, which has a peculiar odour, recalling that of chloropicrin, is heavier than water; the solid compound crystallises in needles, and is identical with the trichlororcin described below. When heated with concentrated sulphuric acid it blackens and decomposes, giving off hydrochloric acid. It dissolves in nitric acid by the aid of heat, and crystallises out unchanged on cooling. The addition of water to the solution precipitates the pentachlororcin. By long boiling with the acid it is decomposed with evolution of nitrous fumes.

Analysis of Pentachlororcin.

I. 0·901 grm. substance gave 0·937 grm. carbonic anhydride and 0·096 grm. of water.

II. 0·196 grm. substance gave 0·473 grm. argentic chloride.

III. 0·360 grm. substance gave 0·871 grm. argentic chloride.

IV. 0·229 grm. substance gave 0·555 grm. argentic chloride.

V. 0·202 grm. substance gave 0·488 grm. argentic chloride.

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[*] Read before the Royal Society. A Preliminary Notice of several of the compounds described in this paper appeared in the CHEMICAL NEWS, vol. xxiii. p. 230, and *Zeits. Chem.*, vol. vii., p. 229.

[†] *Ann. Chem. Pharm.*, vol. liv., p. 271.

[‡] *Phil. Trans.*, 1848, p. 88, and *Ann. Chem. Pharm.*, vol. lxvii., p. 97.

[§] *Ann. Chem. Pharm.*, vol. cxxx., p. 34; Kekulé's "Benzolderivate," vol. i., p. 338.

Theory.			I.	II.	III.	IV.	V.	Mean.
C_7 =	84·0 =	28·33	28·36	—	—	—	—	28·36
H_3 =	3·0 =	1·01	1·18	—	—	—	—	1·18
Cl_5 =	177·5 =	59·87	—	59·70	59·85	59·96	59·75	59·82
O_2 =	32·0 =	10·79	—	—	—	—	—	—
	296·5							

V. was prepared by the action of potassium chlorate and hydrochloric acid; I., II., III., and IV. by means of chlorine hydrate. The substance was dried *in vacuo.*

Terchlororcin, $C_7H_5Cl_3O_2$.—When pentachlororcin was heated with hydriodic acid to 100° it was decomposed, terchlororcin being formed and iodine set free. The best method of conducting the operation, so as to obtain a pure product, was to add the pentachlororcin in small portions to a mixture of amorphous phosphorus and hydriodic acid, containing 8 or 10 per cent of iodine, and to digest between each addition until the liberated iodine had been re-converted into hydriodic acid. When all the pentachlororcin had been introduced, the digestion was continued until the trichlororcin appeared as a colourless oily layer at the bottom of the flask. On cooling, a considerable portion more crystallised out of the hydriodic acid in colourless needles. The oily trichlororcin, which solidified on cooling, was dissolved in a small quantity of spirit, filtered to separate it from the excess of amorphous phosphorus, and the alcoholic solution precipitated by water. The amount of crude product thus obtained was about 75 per cent of the weight of the pentachlororcin originally employed. One or two crystallisations from boiling water slightly acidified with acetic acid rendered it quite pure. If very pure pentachlororcin had not been employed in the preparation the crude product was more or less coloured, and could only be purified with considerable difficulty, as the colouring-matter adheres to the trichlororcin with great obstinacy. It was found, however, that several alternate crystallisations from benzol and petroleum oil, and a final crystallisation from water, almost entirely removed the brown colouring matter. It fuses to an oil under boiling water, in which it is moderately soluble, crystallising out almost completely on cooling in long colourless transparent needles, which become white and opaque when exposed to the air. It is but sparingly soluble in carbon disulphide, moderately in petroleum oil, rather more so in benzol, and excessively soluble in ether and alcohol. It is soluble in boiling glacial acetic acid, and crystallises out on cooling in thin transparent plates, which become white and opaque on the addition of water. Trichlororcin melts at 123°, and when heated to a very much higher temperature it blackens and gives off hydrochloric acid, even under diminished pressure. It cannot, therefore, be distilled *in vacuo*, but it passes over readily with the vapour of water. When heated for several hours to 180° with moderately strong hydriodic acid and phosphorus, it was found to be re-converted into orcin, which could be extracted from the solution by agitating it with ether. The addition of alcoholic ammonia to a solution of the trichlororcin in alcohol threw down a white crystalline precipitate, but slightly soluble in water or alcohol. This compound, when dissolved in a large excess of dilute aqueous ammonia, and submitted to the action of metallic zinc in a close vessel at the ordinary temperature, yielded a colourless solution. On exposing this to the air, however, it acquired a fine blue colour, which was changed to red by the action of acids. Further investigation will no doubt show the nature of this compound.

Analysis of Trichlororcin.

I. 0·257 grm. substance gave 0·486 grm. argentic chloride.

II. 0·302 grm. substance gave 0·572 grm. argentic chloride.

III. 0·216 grm. substance gave 0·293 grm. carbonic anhydride and 0·046 grm water.

Theory.			I.	II.	III.	Mean.
C_7 =	84·0 =	36·93	—	—	37·00	37·00
H_5 =	5·0 =	2·20	—	—	2·37	2·37
Cl_3 =	106·5 =	46·81	46·78	46·86	—	46·82
O_2 =	32·0 =	14·06	—	—	—	—
	227·5	100·00				

I. was from the pentachlororcin prepared by the action of chlorine hydrate on orcin; II. and III. from that prepared by hydrochloric acid and potassium chlorate. The substance was dried *in vacuo.*

This trichlororcin differs considerably in its melting-point and other properties from that described by De Luynes[*] as formed by the action of hydrochloric acid and potassium chlorate on orcin. Moreover, although many attempts were made to prepare trichlororcin by his method with varying proportions of the materials, pentachlororcin was invariably obtained, contaminated, however, in some instances, with a large amount of viscid oily impurities. I conclude, therefore, that De Luynes's trichlororcin was either isomeric with that above described or that it was an impure substance.

Bromorcin.

Pentabromorcin, $C_7H_3Br_5O_2$.—This compound was readily formed by the action of an excess of bromine on orcin. Seven parts of bromine and about 200 of water were placed in a stoppered bottle, and a moderately strong aqueous solution of one part of orcin added by small portions, with constant agitation. The yellow crystalline product thus obtained, amounting to 370 per cent of the weight of the orcin, was then collected, and purified by repeated crystallisation from carbon disulphide, in a manner similar to the corresponding chlorine compound. It is almost insoluble in water, very soluble in alcohol and ether, and moderately so in benzol and carbon disulphide, from the latter of which it may be obtained in very large and almost colourless transparent crystals. It melts at 126°, and when boiled with water appears to undergo a decomposition similar to the pentachlororcin. Heated with concentrated sulphuric acid it gradually dissolves, and on continuing the heat hydrobromic acid and bromine are evolved in abundance. Like the corresponding chlorine compound, it dissolves in hot nitric acid, crystallising out again on cooling, but is at the same time far more readily decomposed. When boiled with amorphous phosphorus and moderately strong hydriodic acid it is rapidly decomposed, and passes into solution probably as orcin. With very weak hydriodic acid, however, containing about one per cent of iodine and excess of amorphous phosphorus, the decomposition takes place more gradually, and a heavy oily layer is obtained, which solidifies on cooling. This, after purification, was found to be identical with the tribromorcin described by Stenhouse,[*] and subsequently examined by Laurent and Gerhardt,[†] and by Samparter.[‡]

Analysis of Pentabromorcin.

I. 0·578 substance gave 1·046 argentic bromide, which is equivalent to 77·00 per cent bromine; the formula $C_7H_3Br_5O_2$ requiring 77·07 per cent.

Pentachlororcin hypochlorite,

$$C_7H_4Cl_6O_3 = C_7H_3Cl_5O_2,HClO.$$

A white crystalline substance was obtained in endeavouring to prepare pentachlororcin by the action of calcium hypochlorite and hydrochloric acid on orcin; but as it appeared to differ somewhat from that compound it was carefully examined. After some trials the following was found to be the best method of preparation:—Five parts of orcin were dissolved in a mixture of four measures of hydrochloric acid, sp. gr. 1·17, with four measures of water; and this solution was then gradually added to a

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[*] *Ann. Chem. Pharm.*, cxxx., p. 34; Kekulé's "Benzolderivate," i., p 388.

[†] *Phil. Trans.*, 1848, p. 87.

[‡] *Ann. Chem. Phys.* [3], vol. xxiv., p. 317.

[§] *Ann. Chem. Pharm.*, vol. xxxiv., p. 257.

moderately strong clear solution of calcium hypochlorite, taking care to leave the latter in excess. The liquid, which has a milky appearance, was then strongly acidulated with hydrochloric acid, and allowed to stand 24 hours, when it deposited a considerable quantity of white crystals. These were collected, dried, and purified by crystallisation from benzol, as, unlike pentachlororcin, they are but sparingly soluble in carbon disulphide. When pure it crystallises in transparent prisms of great dispersive power. It is very soluble in ether, moderately so in light petroleum oil, and almost insoluble in water. When heated with hydriodic acid and phosphorus it is decomposed, but apparently without the formation of trichlororcin. It is very soluble in alcohol, and after boiling the solution for some time, the addition of water causes the precipitation of an oil, which solidifies if exposed to the air for a few days. When the substance is boiled with water the latter becomes milky, and gives off pungent vapours. The hypochlorite dissolves in hot nitric acid, and crystallises out on cooling; hot concentrated sulphuric acid decomposes it. It has a considerably higher melting-point than pentachlororcin, namely 140·5°. The following results were obtained by analysis:—

I. 0·272 grm. substance gave 0·240 grm. carbonic anhydride and 0·033 grm. water.

II. 0·274 grm. substance gave 0·242 grm. carbonic anhydride and 0·032 grm. water.

III. 0·257 grm. substance gave 0·633 grm. argentic bromide.

IV. 0·147 grm. substance gave 0·361 grm. argentic bromide.

Theory.			I.	II.	III.	IV.	Mean.
C_7 =	84 =	24·07	24·06	24·08	—	—	24·07
H_4 =	4 =	1·15	1·31	1·34	—	—	1·32
Cl_6 =	213 =	61·03	—	—	60·94	60·75	60·85
O_3 =	48 =	13·75	—	—	—	—	—
	349	100·00					

The rational formula deduced from the percentage composition of the substance is $C_7H_4Cl_6O_3$, and I propose to give it the provisional name of *pentachlororcin hypochlorite*, $C_7H_3Cl_5O_2$, HClO, until its constitution is more satisfactorily made out by an examination of the products of its decomposition.

Chlorresorcin.

Pentachlorresorcin, $C_6HCl_5O_2$.—An attempt was made to obtain a chlorresorcin by submitting resorcin to the action of chlorine hydrate in a manner similar to that which had been so successfully employed in preparing pentachlororcin, but the results obtained were unsatisfactory, the product being very small in comparison to the resorcin taken, and even that so contaminated with oily impurities that further examination was deemed inexpedient. The action of potassium chlorate and hydrochloric acid, however, gave a much more favourable result. Five parts of potassium chlorate and a solution of two parts of resorcin in eight of hydrochloric acid were gradually added to forty parts of hydrochloric acid, which was prevented from becoming very hot by immersion in cold water. The operation was conducted in a manner similar to that previously described in the preparation of pentachlororcin, but more care was required to obtain a successful result, and the amount of product was comparatively small, about 70 per cent of the resorcin. The crystalline compound which is deposited on standing was collected, and, after being simply pressed to remove some of the mother-liquor, boiled with a considerable quantity of carbon disulphide. The supernatant aqueous layer was then separated by means of a separating-funnel, and the greater portion of the carbon disulphide removed by distillation. When sufficiently concentrated the anhydrous chlorresorcin crystallised out in brilliant colourless plates or flattened prisms. One or two re-crystallisations rendered it pure. The crude product of the action of the chlorate and hydrochloric acid on resorcin appeared to consist principally of a hydrate of the chlorresorcin, as when it was rapidly heated for a short time with a comparatively small proportion of carbon disulphide, and the solution filtered, it deposited a white crystalline compound in minute scales, sparingly soluble in the disulphide. On submitting the solution to distillation, however, to remove the excess of carbon disulphide, water passed over with the latter, and the solution, when sufficiently concentrated, deposited large crystals of the anhydrous substance. Pure pentachlorresorcin is colourless, and melts at 92·5°. It is moderately soluble in warm water, from which it separates on cooling in a white opaque mass of indistinct crystals, apparently the hydrate. It is readily soluble in carbon disulphide, benzol, and petroleum oil, and very soluble in alcohol and ether.

Analysis of the Chlorresorcin.

I. 0·476 grm. substance gave 0·447 grm. carbonic anhydride and 0·020 grm. water.

II. 0·308 grm. substance gave 0·289 grm. carbonic anhydride and 0·013 grm. water.

III. 0·193 grm. substance gave 0·490 grm. argentic chloride.

IV. 0·259 grm. substance gave 0·659 grm. argentic chloride.

Theory.			I.	II.	III.	IV.	Mean.
C_6 =	72·0 =	25·49	25·56	25·60	—	—	25·58
H =	1·0 =	0·35	0·47	0·47	—	—	0·47
Cl_5 =	177·5 =	62·84	—	—	62·81	62·95	62·88
O_2 =	32·0 =	11·32	—	—	—	—	—
	282·5	100·00					

The results of the analysis correspond very nearly to the formula $C_6HCl_5O_2$, that of pentachlorresorcin. This somewhat anomalous composition was, however, confirmed by the analyses of the corresponding bromine compound.

Bromresorcin.

Pentabromresorcin, $C_6HBr_5O_2$.—This compound was prepared by adding resorcin solution to a mixture of bromine and water, in a manner similar to that employed in the preparation of pentabromorcin. It is, however, advantageous to use considerably less water (about one-fifth), and to moderate the heat produced during the reaction by occasionally immersing the bottle in cold water. Two or three crystallisations from carbon disulphide serve to purify the product, which then forms large colourless or faintly yellow prismatic crystals. The pure pentabromresorcin melts at 113·5°. It is almost insoluble in water, but readily soluble in ether and alcohol, from the latter of which it is precipitated on the addition of water. It is also moderately soluble in cold benzol and in hot petroleum oil, from which it crystallises out in great part on cooling. Treated with hydriodic acid it yields a colourless compound, crystallising in needles, probably tribromresorcin.

Analysis of Pentabromresorcin.

I. 0·382 grm. substance gave 0·712 grm. argentic bromide.

II. 0·292 grm. substance gave 0·544 grm. argentic bromide.

Theory.			I.	II.	Mean.
C_6 =	72 =	14·25	—	—	—
H =	1 =	0·20	—	—	—
Br_5 =	400 =	79·21	79·30	79·27	79·28
O_2 =	32 =	6·34	—	—	—
	505	100·00			

The analyses of those chlorine and bromine derivatives of resorcin that have just been described thoroughly establish the existence of the compounds $C_6HCl_5O_2$ and $C_6HBr_5O_2$, which closely resemble in their properties the corresponding pentachlororcin, $C_7H_3Cl_5O_2$, and pentabromorcin, $C_7H_3Br_5O_2$, obtained from ordinary orcin. The view of the constitution of the orcins put forth by Kekulé, who regards them as dihydroxyl derivatives of the benzols, is scarcely in accordance with the method of formation and composition of these compounds, as in the case of the pentabromresorcin five hydrogen atoms in the resorcin are undoubtedly directly replaced by bromine, although one of them, according to Kekulé's view, exists as hydroxyl.

An attempt was made to prepare the resorcin body corresponding to that obtained from orcin by the action of calcium hypochlorite and hydrochloric acid, and which I have designated pentachlororcin hypochlorite, but without success. The product was a very viscid oil, which showed no signs of solidification even after standing for some weeks, and from which I was unable to obtain any crystalline compound.

NOTE ON CUPREOUS OXIDE.

By C. T. KINGZETT.

During some recent researches I had occasion to ascertain if cupric oxide is formed by blowing air through water holding in suspension cupreous oxide.

In view of this object, a considerable quantity of cupreous oxide was prepared by the addition of a strong solution of ordinary moist sugar to a solution of cupric sulphate after treatment with an excess of potassic hydrate.

The Cu_2O was washed thoroughly first by decantation (the readiest method), and afterwards upon a filter. It was then approximately dried at 212° F.

(*a.*) The value of 10 grs. by weight, ascertained by the method based upon the following reaction:—

$$Cu_2O + Fe_2Cl_6 + 2HCl = \\ = 2CuCl_2 + 2FeCl_2 + H_2O,$$

and titration of the ferrous chloride thus formed with a standard solution of potassic bichromate. 10 grs. contained actually 9·13 grs. Cu_2O.

(*b.*) 9·13 grs. Cu_2O placed in 1000 grn. measures of "steam-water," and air blown through for three hours, keeping the vessel hot by the aid of a Bunsen burner (a cylindrical vessel serves best—such as a big "boiling-tube.")

The Cu_2O did not alter in appearance, and on determining the Cu_2O left after blowing it was found that *none had peroxidised.*

(*c.*) Same as (*b*) repeated *cold.*

Same results as in (*b*).

After performing these simple experiments it occurred to me that the presence of an alkali might induce peroxidation.

(*d.*) 9·13 grs. Cu_2O placed in 1000 grn. measures of a solution containing 20 grs. pure sodic hydrate. Heated by Bunsen burner and air blown through for one hour.

After experiment, the Cu_2O left was 4·5 grs.; therefore, 50 per cent (roughly) had been peroxidised.

The NaHO left in solution was also estimated by standard hydric sulphate.

The whole of the 20 grs. originally present was found still in solution.

(*e.*) This was (*d*) repeated, using 10 grs. NaHO and blowing for three hours. 2·3 grs. Cu_2O were left behind. 75 per cent (roughly) had been peroxidised. All the alkali remained unaltered in solution.

(*f.*) This was (*e*) repeated. Blowing five hours. The whole of the 9·13 grs. Cu_2O peroxidised. All the alkali remained unaltered in solution.

The progress of the peroxidation may be watched by the gradual blackening of the scarlet-coloured Cu_2O: this "blackening" occurs only slowly if Cu_2O suspended in an alkaline solution be left in *contact* merely with the air.

As might be expected, the peroxidation (as determined by other experiments, continued for equal times and with the same rates of blowing) proceeds far more rapidly hot than when cold.

As already stated, the preceding experiments were made with Cu_2O that had been *dried.*

A similar series were made with recently precipitated Cu_2O without drying, but exactly similar results were obtained.

How the hydrated cupreous oxide $4Cu_2O,H_2O$, prepared by addition of potassic hydrate to cupreous chloride would behave when made the subject of parellel experiments, I have not yet had an opportunity of deciding.

No doubt caustic soda or potash induces the peroxidation of anhydrous cupreous oxide as they do the oxidation of ethylic alcohol to acetic and formic acids,—that is, by a catalytic action. It is just possible that Na_2O_2 or K_2O_2 may be temporarily formed and almost spontaneously decomposed.

Whilst experimenting with cupreous oxide, I conceived the idea that it might decompose potassic bichromate and be oxidised to cupric oxide at its expense. Accordingly,

(*g.*) 9·13 grs. Cu_2O were boiled with 1000 grn. measures of standard bichromate solution, capable of peroxidising 50 grs. $FeSO_4,7H_2O$. Filtered and washed, and filtrate and washings examined. They oxidised 50 grs. of ferrous sulphate.

The Cu_2O had not altered in appearance. This experiment therefore shows that, unlike cupric oxide, cupreous oxide is without action upon potassic bichromate.

FIBRIN: ITS ORIGIN AND SOURCES OF DEVELOPMENT IN THE ANIMAL ORGANISM;

VERITABLE FIBRIN BEING PROVED TO BE DERIVED FROM ALBUMINOUS SUBSTANCES BY THE AGENCY OF WATER.

By JOHN GOODMAN, M.D., &c.

The intense importance of the inquiry which is the subject of this paper is well known to all physiologists.

The author having read a paper on this subject at the Liverpool meeting of the British Association, which is published in the report, has been since that period engaged in attempting to prove, by a long and complete series of experiments, the truth then set forth.

The following is an epitome of the results arrived at:—

1. Albumen, from the egg, suspended in ropes in cold and pure water, and exposed for some little time to its influence, loses its character of albumen, and assumes the nature, appearance, and constitution of fibrin spontaneously. Thus, it coagulates, and independently of the application of heat, and becomes solid and insoluble—characteristics which distinguish fibrin from all other analogous substances (see Dr. "Miller's Organic Chemistry," Part III., p. 800).

2. Under the microscope, which was used in all these experiments, when thus transformed by water, it exactly resembles blood fibrin, with the reactions, &c., of which it was constantly compared. So great was the resemblance that a medical gentleman from Manchester selected this substance under the microscope for the real genuine blood fibrin, in preference to a specimen of the fibrin substance itself.

3. *Intense Affinities and Formative Qualities.*—Blood fibrin, and especially this substance, differ from albumen in possessing intense attractive powers and affinities, which appear to be the secret cause of the formative qualities of fibrin; causing it to form, in definite lines, into rods and substances, &c., which evince the presence of a controlling constructive power, and enabling it to assume forms and grotesque figures, of which it might be said that nothing but vitality was wanting to endow them with the character of living beings. In several instances, the fibrin *ab* albumen as we will now call it, manifested decided electrical attraction, for it was drawn aside and out of its perpendicular, in several instances, some ¼ inch or so, by attractive influence towards a copper wire when raised from the water. On the other hand, albumen presents itself as a homogeneous, motion-

less, and shapeless mass, and entirely destitute of these powers and characteristics.

4. Like blood fibrin, it was found to decompose peroxide of hydrogen with effervescence, whilst, as stated by Dr. Miller (p. 806), "albumen produces no such effect." Again, Dr. Miller tells us that neutral salts, mixed with blood, on abstraction, prevent its coagulation. This we found to be the case with regard to this substance—even sea water prevented, in a great measure, the transformation.

5. *Is Oxygen capable of effecting this change.*—Dr. Miller declares (p. 807) that "There is a great difference between the action of oxygen on albumen and fibrin. That the former, when exposed to oxygen, enclosed in a glass tube, over mercury, indicates scarcely any absorption of the gas, and little or no carbonic anhydride is eliminated; but when coagulated fibrin is exposed, in a moist state, to the air, it gradually absorbs oxygen, emits carbonic anhydride, and in a few days becomes putrid." I found that fibrin *ab* albumen, as well as blood fibrin, has a great affinity for oxygen, especially when moist and verging on decomposition, whilst albumen, in ropes hung up in the atmosphere, remained untirely unchanged in its nature, save that it became a brittle rod.

In order to show that oxygen of the air takes no part in this transformation (in Expts. 102, 103), I found that the transformation of albumen into fibrin proceeded exactly similarly in two bottles, the one closed by a stopper, the other open to the atmosphere—no perceptible difference occurring between them for days and even weeks.

In all these experiments I have not discovered one instance in which oxygen has shown itself capable of effecting any change in albumen without the previous intervention of water.

6. There is, however, an experiment on record, as given by Dr. Carpenter, in which Mr. Smee is said to have produced a substance presenting numerous points of similarity to fibrin, if not identical with it, by passing oxygen through defibrinated blood serum to which ordinary ov-albumen has been added, or through albumen slightly acidified with acetic acid (see Dr. Carpenter's "Principles of Physiology," p. 56).

In these experiments, pure ov-albumen, or albumen alone, was not employed. In the one case it was mixed with blood serum, and perhaps with water, of which we are not informed, and in the other with acetic acid.

7. In the first experiment by Mr. Smee the serum employed had been of course exposed to the agency of water in several instances in the animal organism, and therefore, even when defibrinated, as shown by Muller,* and mixed with water, coagulates after passing a filter. In the other acetic acid was used, and the water which it contains was, we contend, sufficient to induce the change in question.

But there are no acetic or other strong acids in the lymphatics and lacteals in which fibrin is at first seen to derive its origin, and therefore the latter experiment has nothing to do with the subject in hand.

I find, by experiment, that we have in blood serum always—

(1). Already formed fibrin in solution ready to coagulate.

(2). Do., do., which will manifest itself on exposure to the air.

(3). The remaining albumen, which is all capable of transformation by being diluted with water.

Ov-Albumen with Oxygen.

Expt. 99.—In order to prove or disprove Mr. Smee's experiment as regards simple albumen itself, I exposed *ov.* albumen to a stream of oxygen in a glass tube for six hours, and afterwards for forty-eight hours to bubbles of the same still remaining in the albumen. At the end of this time its transparency remained unaltered,—it was slightly more yellow—and the bubbles were somewhat diminished in size. There was no appearance under the microscope of any fibrin having been formed. The albumen was unchanged.

8. *Expt.* 100.—In order to show the effect of the addition of water to the above, the tube and contents were merely washed out with the same, when it at once assumed an opaque white appearance. In five to ten minutes, under the microscope, fibrous rods and other formations began to manifest themselves, and after two days' exposure to water, the whole had become changed completely into fibrinous material.

Gulliver kept horses' blood fluid with nitre for 57 weeks, yet it readily coagulated when diluted with water (Dr. Carpenter's "Physiology," p. 238).

9. These experiments therefore declare that oxygen is not the producing cause of this transformation, but albumen requires first the agency of "moisture," "dilution," or water, to change it into fibrin before oxygen can exert any influence upon it of this kind. Afterwards, it seems to endow it with new qualities and a higher state of organisation, and gives, as it were, the finishing touch to this important product. Such also appears to be the case in the animal organism. Albumen is transformed into fibrin by water in the lymphatics and lacteals, &c., and afterwards in the liver and vena cava by water absorbed by the gastric veins, and then its organisation is rendered perfect and complete by respiration.

In the animal and vegetable kingdom we observe that the most tiny animalcule or vegetable substance does not start into existence independently of the presence of water. It appears that fibrin has to be first formed by the action of water before even the germ can exert its living influence upon it and develope a living being, and endow it with its own nature and species. We also notice that fermentation, decomposition, and scarcely any chemical change in living or dead organic substances can occur without the presence of water.

It appears, moreover, that this substance, fibrin *ab* albumen, exactly resembles fibrin when first formed in the lymphatics. Dr. Carpenter has shown that the latter differs from blood fibrin in its inferior tendency to putrefaction (p. 180), whence, says he, "It may be inferred that it has not undergone its complete vitalisation." This substance also possesses a very low degree of putrefactive tendency, for it remained in water three whole weeks (see Expt. 5), perfectly white and beautiful, as on its first formation, and did not become decomposed for several days afterwards. Oxygen, however, evidently confers upon fibrin increased attractive and formative qualities; many more rods, &c., presented themselves generally after this substance had been exposed to the air in most of these experiments.

10. *Expts.* 105, 107, 108, 109.—When the cold water was exchanged for that of blood heat, *i.e.*, from 98° to 100° or more F., no difference was observable in the rapidity or potency of the transformation.

11. Mr. Smee is said, moreover, to have produced a substance very similar to, if not identical with, fibrin, "by feeble currents of electricity passed through an albuminous fluid, where it accumulates round the positive pole." It appears pretty clear that water was here employed,—by the words "fluid" and "accumulation" round the pole being used (see Dr. Carpenter's "Principles of Physiology," p. 56).

Ov-Albumen with the Voltaic Current.

Expt. 116.—In order to test this experiment more particularly, I employed ov-albumen alone between the two platina poles of a voltaic battery of six cells.

I found that there were only a very few small specimens of fibrin produced under the microscope, but that the albumen, by decomposition and effervescence, became less and less fluid, the fibrin apparently being transformed by the water of fluidity,—compelled, as it were, by the

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* "Elements of Physiology," by J. Muller, M.D., translated by Dr. Baly (p. 124).

influence of the voltaic current,—and very shortly all transformation ceased. After a time, the albumen became a thickened and ultimately a solid mass. On examination, it was found to consist almost entirely of unchanged albumen, as the specimen which we have here manifests.

Ov-Albumen with Water and the Voltaic Current.

12. *Expt.* 110.—I employed water in this experiment and those following in conjunction with the voltaic current. In half a minute the albumen became covered with dense and opaque whiteness, showing that, in contrast with the other experiments, in which the influence of water only was used, the rapidity of transformation was, by electric agency, greatly increased.

Expt. 112.—The change to dense and opaque white was again effected in about half a minute. With older ov-albumen there is usually an increase in the amount of gas eliminated. Here we had a globule of albumen immersed in water midway between the poles, which was found to be a great advantage. In this experiment I perceived a dense dark brown ring of fibrin forming around each bubble of gas, which we have preserved, and which can now be seen in the specimen. In fifteen minutes fibrinous rods were seen shooting forth like the fingers of a human hand (one of the most beautiful exhibitions I ever witnessed), towards the negative pole or in the lines of current.

All these experiments, together with 113 and 115, in which, apparently, thousands of ovoid corpuscles made their appearance, many of which were attracted in beautiful lines, and formed rods, and many of them can still be seen in the specimen, resulted in the formation of perfectly formed fibrin, without scarcely a vestige of unchanged albumen being left.

Dr. Miller declares (p. 808) that, when fibrin is treated with acetic acid under the microscope, it is found to consist of two portions, one of which is granular and soluble in acetic acid, while the other is fibrinous and insoluble. This we found to be a graphic description of what took place with *ab* fibrin albumen.

Fibrin *ab* albumen remained unchanged in water for three entire weeks. But about the 25th day (the water being muddy with albuminous matter) it began to break up bodily into fibrinous rods and shreds of an indubitable character.

Epitome of Chemical Experiments.

I.—*Solution.*

Expt. 9 and 69.—Fibrin *ab* albumen dissolved in 3 mins. in liq. potassæ.

Expt. 66.—Blood fibrin was completely dissolved in twelve hours, whilst ov-albumen required more than twenty-four hours to effect its solution without heat. Here this substance was much more dissimilar to albumen than even blood fibrin itself.

Expt. 52.—In strong hydrochloric acid, fibrin *ab* albumen and blood fibrin both dissolved in twenty-four hours, whilst ov-albumen was not completely dissolved in sixteen days.

II.—*Precipitated Solutions.*

In solution in acids precipitated by alkalies—and in alkalies precipitated by acids—this substance always manifested the same reactions as blood fibrin, and also equally differed from those of albumen. Expts. 57 to 63 and 68.

In the fibrinous solutions precipitated, we had always fibrinous rods and formations of fibrin without the coagulum peculiar to albumen. In the solutions of albumen precipitated, we had as invariably a dense and dark or light coagulum, without fibrinous rods and formations.

Moreover, in alkaline solutions of albumen with acetic acid, we had always a dense white and flocculent coagulum; and when precipitated by nitric acid, as stated by Dr. Miller,* a lemon-yellow precipitate, whilst neither coagulum nor colour were present in the precipitates from solution of fibrin *ab* albumen, or blood fibrin.

The results of these experiments again and again repeated have been so marked, so harmonious, and constant, under the microscope, as to give them a conclusiveness which demands our most serious consideration and attention.

(To be continued).

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* Dr. Miller's "Organic Chemistry," part iii.

SEWAGE AS A FERTILISER OF LAND, AND LAND AS A PURIFIER OF SEWAGE.*

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(Continued from vol. xxiv., p. 309)

I. *Chemical Treatment of the whole of the Sewage at the Mouth of the Sewer.*

Leaving out of consideration all treatments which aim only at the purification of the sewage, without turning its fertilising properties to use, as irrelevant to my subject, I will confine my observations to those chemical processes by which both these objects are said to be obtained. Many processes have been before the public aiming at this end, and several have been patented, and afterwards brought forward by public companies.

The Native Guano Company, better known as the company possessing the patent of the "A B C Sewage Process," now stands very prominently before the public in consequence of its shares being at a high premium, and because arrangements have been made by the authorities of Hastings, Leeds, Bolton, and Southampton, as well as by the Metropolitan Board of Works, to test, by comprehensive experiments, the value of the process, although it had been superseded at Leamington by irrigation. The initials "A B C" indicating the principal ingredients of the chemical mixture, viz., alum, blood, and clay, by which it is stated the polluting and fertilising parts of sewage may be precipitated and made available as a manure. I do not propose to enter into any details of the process itself, but will merely state that the specification of the patent sets forth that 4 lbs. of mixture are required for every 1000 galls. of sewage treated; and that Mr. Rawson, the general manager of the company, tells me that 100,000 gallons of sewage of average strength—diluted to the extent of 30 gallons a day—will produce from 20 to 25 cwts. of dry manure; from which statement we see that, if the specified proportion of mixture to sewage were adhered to, 400 lbs. of mixture will be required for the production of a ton of saleable manure. The company declare that deodorisation takes place immediately on the first addition of the A B C mixture, and in proof of the purification effected, give the following analyses:—

Comparative Analysis in Grains per Gallon.

	Average of 50 samples.	
	Sewage.	Effluent Liquid
Organic Matter	17·2	1·4
Mineral matter	37·4	16·9
Total	54·6	18·3

I will now offer such evidence as I can of what the Native Guano Company can do towards the purification of sewage and the extraction of its fertilising parts, premising that Mr. Rawson has most courteously afforded me every facility for ascertaining the results arrived at by farmers and gardeners who have used the manure sold by the company.

The Rivers Pollution Commissioners, having made very careful experiments at Leicester and Leamington, state

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* Read before the Society of Arts, December 6, 1871.

in their second report (dated July 4th, 1870), that the process removes a very small proportion of the soluble polluting matter from sewage, and that "the manure obtained has a very low market value, and cannot repay the cost of manufacture." Their analysis of the effluent liquid, made of samples taken on the 10th of May, 1870, showed the following result, although the quantity of mixture used was increased very largely beyond the proportion prescribed in the specification (4 lbs. to 1000 gallons of sewage).

Analysis expressed in parts per 100,000:—

Total solid matter in solution ..	123·050
Organic carbon	4·727
Organic nitrogen	1·892
Ammonia	8·060

These figures are very much in excess of those I have just quoted as given by the company; though, if the latter were compared with either the standard of purity suggested by the Rivers Pollution Commissioners or that recommended to the Thames Conservators, it will be seen that the condition indicated is not such as to render the effluent liquid admissible into running streams. How Leeds and the other towns mentioned will ultimately conform to a national standard of purity remains to be seen. As to the manure made by the Native Guano Company, the Commissioners said that "the so-called A B C manure is little more than the original suspended solid matter of raw sewage, plus the insoluble materials added in the A B C mixture, 19-20ths of this being merely clay."

The chemists employed by the Metropolitan Board of Works state, through Dr. Odling (June 24th, 1870), when speaking of this process, that, after examination, they found "there was a great deal of putrescible matter in the effluent liquid; and in comparing this mode of precipitation with others, it did not seem that its alleged superiority had any foundation."

Dr. Voelcker, in the *Journal of the Royal Agricultural Society* (vol. vi.. S.S., Part II.), having analysed five different samples of the manure sold as native guano, stated the result to be as follows:—

	£	*s.*	*d.*	
No. 1 sample was worth ..	0	18	6	per ton
2 ,, ,, ..	1	13	6	,,
3 ,, ,, ..	0	14	0	,,
4 ,, ,, ..	0	18	6	,,
5 ,, ,, ..	0	14	6	,,

basing his value on a comparison of the manure with phosphate of lime at £10 a ton, and ammonia at £60 a ton.

Still, in the face of these adverse opinions, expressed by the highest chemical authorities of the country, the Native Guano Company is advertising its dried manure at £3 10s. per ton, and are finding customers at that price. Some farmers and gardeners with whom I have corresponded speak very favourably of it, and declare their intention of buying more, while others say they have not been able to distinguish any advantage from the use of it, and one farmer goes so far as to threaten an action for injury done by its use. On the whole, the replies I have received do not lead me to the conclusion that the sale of the manure will be very great after public curiosity is satisfied, for it is more than probable that the sales that have taken place have resulted from the desire to give the manure a trial, under a false notion that because Peruvian guano is advertised at £13 5s. a ton, and phospho-guano at £11 10s. a ton, "native guano" must be cheap at £3 10s. a ton. If, however, the sale should continue, the failure of the process to effect purification up to any recognised standard must act as a veto to its adoption, except in those cases where the authorities of towns may be content with clarified in the place of purified sewage.

The Phosphate Sewage Company, founded on a patent taken out by Dr. David Forbes, of which dissolved phosphate of alumina for precipitation is the base, aims at doing all that the A B C process professes to do, with the additional recommendation of being associated with irrigation where circumstances favour the adoption of the two processes, which, seeing that the separation of the coarser solid parts of sewage from the liquid is a desideratum in irrigation, may frequently be the case. The company state that, "if phosphate of alumina alone is used, the sewage is defecated, the solid matter is precipitated, and the water is left still maintaining all its nitrogenous and valuable properties, plus any excess of phosphoric acid which has been added, and, therefore, highly useful for the irrigation of cereals and other crops, and at the same time perfectly inoffensive. This process will be adopted where it is deemed desirable to use the water as a fertilising agent for irrigation purposes, since it possesses advantages, both in an agricultural and sanitary point of view, above any system of sewage irrigation hitherto used. In the case of towns to which sewage irrigation is inapplicable or disadvantageous, and which are desirous of rendering their sewage water sufficiently clear and pure to return into a river or stream, this object can be effected by adding a small quantity of lime to the sewage after treatment by the former process." This company, in fact, declares itself able not only to purify sewage to a degree to render it admissible into rivers, and to manufacture a manure out of the precipitated matter, but to render the effluent liquid more suitable for irrigation than the sewage itself. These statements are made on the authority of Dr. Voelcker. The analysis of the effluent liquid discharged during certain trials at Tottenham gives the following result in grains per imperial gallon:—

Organic matter—		
In solution	5·74	
In suspension	none	
Total organic matter		5·74
Mineral matter—		
In solution	57·71	
In supension	none	
		57·71
Total solid matter (organic and mineral)		63·45
Organic nitrogen—		
In solution	0·47	
In suspension	none	
Total organic nitrogen		0·47
Equal to ammonia	0·57	
Saline ammonia	3·32	
Total nitrogen calculated as ammonia	3·89	

Compared with the suggested standard of the Rivers Pollution Commissioners, this analysis does not show the requisite amount of purity.

I have endeavoured, from information supplied me by Mr. Lonsdale, the secretary of the company, to obtain some tangible proofs of the value of the manure manufactured by the company; but the number of instances are so few in which actual trial has been made on a scale affording any practical test, that I confess myself unable to draw any deductions whatever; and when stating there can be no doubt that a valuable manure may be made by mixing with the fertilising parts of sewage the phosphate of alumina, it must be borne in mind that there exists no proof that the manufacture will be attended with profit. It must also be remembered that the operations of the company depend upon the supply of phosphate of alumina, which, like all other foreign importations obtained from a distance, must be liable to vicissitudes bearing upon the fortunes of the company, and on the interests of those towns and districts having dealings with it. Associated with irrigation as a never-failing resource when the phosphate may not be forthcoming, or when the manure may not command a sale, such objections would not exist.

With certain seaboard towns, where the effluent sewage need only be clarified to be free from objection, this company, like the Native Guano Company, may probably do a large amount of work, if it should turn out that a saleable manure may be profitably made; though, with the experience we are now having of the power of a small quantity of natural soil to cleanse a large body of sewage by intermittent filtration, and to grow crops at the same time so that the scavenging powers of vegetation may render their aid in purification (as I shall presently show may be the case), it will probably be found more economical to have recourse to that process which is attended with no nuisance whatever, than to establish manure manufactories with all the attendant risks.

Not having any information to offer with regard to the Peat and Engineering Company, nor of any other chemical or chemico-mechanical processes which deal with the sewage at the sewer mouth, I have nothing further to add about that class of treatment. I will merely repeat that it is daily becoming more generally acknowledged, and acted upon, that "the present resources of chemistry appear to hold out no hope that the foul matters dissolved in sewage will be precipitated and got rid of by the application of chemicals to the offensive liquid; and that, therefore, we must look to the direct application of sewage to land wherever it can be obtained for the purpose, as the most desirable means of recovering from water those "ingredients held by it in solution and suspension which do not belong to it, and which render it objectionable and unfit for ordinary and domestic purposes.

II. *Transport of the whole Sewage in its Liquid State from the Sewer Mouth direct to the Land, for Distribution on the Surface.*

So much has been written and said recently on the practice of sewage irrigation, that I should be disposed to say very little on the subject, had not the special properties of the soil itself for appropriating the fertilising matter of sewage, and for cleansing the sewage itself, been, to a very great extent, omitted from consideration, and had not Boards of Health—the worst farmers in the world—been the principal cultivators up to the present time. Believing that, with a recognition that the soil will perform the functions accredited to vegetation as, or more, effectually than vegetation itself, and that the two in combination will obtain the best results, both as a means of profit and as a sanitary agency, I regard all calculations that have hitherto been made as to the number of persons contributing sewage per acre, and the rules that have been laid down on that score, as worth very little as a guide for the future, when the principle shall be fully recognised that the surface of land must be rendered so absorbent that no sewage shall pass off it into the river courses.

In the application of sewage to land, the local features will, in future, decide the question whether the purification of the sewage and its profitable use should be treated as objects of equal importance, or whether the purification should be the paramount object, and utilisation a subsidiary one. If sufficient land for wide irrigation is not to be obtained, or if obtained only at a price that shall place the application of the sewage, by way of irrigation, beyond the possibility of profit, it is manifest that we must call to our aid the cleansing powers of an aërated soil, and regard the land more in the character of a filter than we have hitherto been disposed to do; and by adopting intermittent application, the effect of which has been so admirably explained by the Rivers Pollution Commissioners, realise all the advantages to be gained from it.

The two processes of irrigation and filtration are already viewed so differently from the way in which they were regarded in their first introduction, that it is necessary to state how we stand with regard to them at the present moment. It will be remembered that, up to very recently, an opinion prevailed with respect to irrigation that "the object of getting sewage on to the land was, not to let it percolate into the ground, but to keep it on the surface," and that subsoil drainage would not do for sewage farms, because the sewage passed too rapidly to the roots of vegetation, and descended downwards.

Under-drainage as Essential to Irrigation as to Filtration.—Some members of this Society may remember, on the occasion of my reading a paper on "The Water Supply of the Metropolis, in relation to the Thames and its Tributaries," my friend Mr. Rawlinson, who has ever been the consistent and able advocate of the application of sewage to land, stated in this room, without giving any opinion himself, that some persons practically "acquainted with sewage irrigation would prefer, from their experience, to irrigate clay lands without under-drainage, if Italian rye-glass, which was the most profitable crop, were to be sown; and the little difference of effect that was to be noticed at Norwood, where the land was clay, and the manager had actually plugged the drains in order to keep the land in a state of supersaturation, when compared with Croydon, where the land is free and is naturally drained, has often been quoted as a reason why sewage irrigated land should not be drained. I will not stop to condemn this view, which is repugnant alike to the sanitarian and the agriculturist, as it may be already observed that, with very few exceptions indeed, operators now disclaim the opinion that under-drainage is unnecessary. So decided has the appreciation of drainage become with the majority of sewage irrigators, that in the eagerness to secure rapid absorption, sewage farms have become filter beds of too rapid action, and by the adoption of inappropriate drains the purifying powers of the soil have been jeopardised. Short as the interval has been since intermittent downward filtration was first suggested by the Rivers Pollution Commissioners, that process has, like irrigation, undergone a change. The Rivers Pollution Commissioners stated—evidently under the impression that sewage would only be applied to a barren or fallow surface—"That with a properly constituted soil, well and deeply drained, nothing more would be necessary than to level the surface and divide it into four equal plots, each of which in succession would then receive the sewage for six hours. In this way the sewage of a water-closet town of 10,000 inhabitants could, at a very moderate estimate, be cleansed upon 5 acres of land, if the latter were well drained to a depth of 6 feet." They then go on to state that, nevertheless, there are three formidable objections to the general adoption of the process:—(1) "It is entirely unremunerative." (2) "The whole of the manurial ingredients of the sewage would be absolutely wasted." And (3) "The collection of solid fæcal matters upon the surface of the soil, with no vegetation to make use of them, would probably give rise to a formidable nuisance, especially in hot weather." The change to which I have referred has arisen on the proof which I have had the satisfaction myself of affording, that vegetation may be grown upon the surface of filtering areas, even when receiving sewage equal to the discharged refuse of 3000 persons to each acre, thus adding, in the most apposite manner, to the cleansing powers of the soil the scavengering properties of vegetation. When speaking presently of land as a purifier of sewage, I shall give the particulars of the instance referred to, which, though the first and only case in which intermittent filtration has been tried and modified by the growth of crops, cannot fail to prove that the objections anticipated by the Rivers Pollution Commissioners may be avoided.

Technical Description of Irrigation and Filtration.—With the general admission that under-drainage is essential wherever sewage is applied to the surface of land, it must now be generally understood that irrigation means the distribution of sewage over as many acres as it will wet without supersaturation, having in view a maximum growth of vegetation from the amount of sewage applied, and that any departure from this, resulting in excessive application, is a waste of fertilising matter. It think it may also be taken as proved that filtration through soil should not necessarily mean its application to a fallow or barren surface (as contemplated by the commissioners), but the concentration of the sewage, intermittently, on as few acres of land as will absorb and cleanse it, without excluding the production of vegetation at the same time.

Irrigation.—Having given the interpretation of irrigation as the application of sewage to as many acres as it will wet without supersaturation, I should point out that, owing to the absence of a proper apportionment of the sewage at command to a certain quantity of land, considerable waste has resulted in most instances of sewage farming. The Italian irrigators reckon that they lose half their water when carrying the other half forward for use; and having the advantage of enormous quantities of water to deal with, and a power of regaining that which was absorbed by the soil, by tapping it at a lower level, they are indifferent to loss; but in England, where we reckon the value of sewage by the ton, and have taken its intrinsic value at 1d. per ton, we cannot be content to follow such an example. We must, in fact, in this country reject any mode of distributing sewage which does not aim at the utmost economy, and which I may here state would not be attained, in my opinion, if the average quantity of sewage applied to each acre per annum exceeded 2000 tons, which represents the sewage (proper) of sixty-two persons, with a water supply of 20 gallons a head.

Land may be too Porous.—To judge of the waste resulting from the present mode of applying sewage to the surface of land, we have only to look to the reports of the proceedings of the Lodge Farm, near Barking, published by Mr. Morgan, to whom the public are greatly indebted for the explicit way in which he has given the quantity of sewage applied and of vegetation grown, and we shall see that an average quantity of 4435 tons of sewage per acre were applied during the year ending the 31st of August, 1870, while the quantity used up to the 31st of August last was 3808 tons per acre. If we put ½d. a ton—which I have said sewer authorities ought to receive for their sewage—on each of these quantities, we find that the payment in the first year would have been £9 4s. 9d., and in the last £7 18s. 8d. Turning again to Mr. Morgan's report, it will be seen that as much as 21,488 tons of sewage have been applied per acre in one field of Italian rye grass. This at ½d. a ton would amount to £44 15s. 4d. This is the extreme of the year, but taking the whole of the Italian rye-grass produced, it will be seen that the average quantity of sewage applied from the date of sowing was 288 tons for every ton of rye-grass produced and cut. At ½d. a ton the tenant would have to pay 12s. for this, which is the value of the grass when cut, so that he would suffer a loss of all outgoings in the shape of rent, rates, labour, seed, &c. The waste exhibited by these figures is clearly due to the extreme porosity of the soil, and its unfitness for irrigation on that account.

A Proportion of Clay desirable.—With the limited time at command I must not enlarge upon the advantages certain soils have over others for irrigation. It may be sufficient to state that, if we desire to make the most of sewage, it is necessary that a proportion of clay should exist in the soil, and that, although very stiff clays, from the difficulty attending their management, should be avoided, it is much more likely that soils may be too free than too stiff; I am now, of course, speaking of the retention of the fertilising matter of sewage by the soil, and not of the process of filtration as a means of purification. That is quite another matter. That clayey land is more grateful for sewage is very distinctly shown by Mr. Morgan's report, for the same quantity of Italian rye-grass was produced from clay lands as from free soils, though Mr. Morgan informs me the former did not absorb more than 4000 tons per acre, which is a little more than one-third of the sewage applied to the Italian rye-grass grown on the free soils. I need hardly point out that the rapidity with which land will absorb sewage must depend, not only upon the nature of the soil—its density and porosity—but equally upon the inclination of the surface over which the sewage travels, and the character of under-drainage beneath, and that, therefore, it is the duty of the engineer, when laying out land for absorption, to regulate the inclination of the surface, and the number, position, and size of the under drains *upon which the effect mainly depends* according to the degree of porosity of the soil, in order that a given quantity of sewage may go as far as possible.

Filtration.—Having dwelt upon the practice of irrigation, I ought now to explain the process of intermittent filtration as it may be carried into practice, but as I shall presently deal with it when considering "land as a purifier of sewage," I will only state that by adopting the process as technically described, the liquid refuse of from 1000 to 3000 persons—and probably more—may be cleansed by the soil of a single acre of land.

Return from Irrigation.—Up to this time, though sewage-farming has been practised for some years, we have not obtained sufficient data for the guidance of those who desire to follow it as a business. Although local boards and companies have had the farms in their own hands, no balance-sheets, showing the quantity of sewage applied to, and the money realised by the sale of the various crops grown, have been published. Still, the occasional results that have been obtained affords us positive evidence of what will be done under the management of men practised in the cultivation of land.

The following table exhibits certain results obtained at various places at different dates:—

Description of crop.	Year of production.	Place.	Value of crop per acre.		
Italian Rye Grass	1868	Norwood	22	0	0
	1869	Lodge Farm, Barking	25	0	0
	,,	Norwood	25	0	0
	,,	Edinburgh..	32	0	0
	1870	Lodge Farm, Barking	37	0	0
	1871	,, ,,	22	0	0
	,,	Warwick	12	14	0
	,,	Banbury	13	16	10
Mangolds.. ..	1870	Lodge Farm, Barking	32	0	0
	1871	,, ,,	44	0	0
	,,	Warwick	26	5	0
	,,	Rugby	21	9	0
Swedes	1871	Warwick	26	5	0
	,,	Rugby	18	15	0
	,,	Banbury	14	6	8
Carrots	1869	Lodge Farm, Barking	38	0	0
	1870	,, ,,	45	0	0
	1871	Rugby	45	0	0
	,,	Warwick	35	0	0
Parsnips	1868	Lodge Farm, Barking	35	0	0
	1870	,, ,,	35	0	0
	1871	,, ,,	52	0	0
	,,	Warwick	35	0	0
Cabbages	1868	Lodge Farm, Barking	35	0	0
	1870	,, ,,	15	0	0
	1871	,, ,,	24	0	0
	,,	Banbury	21	11	6
	,,	Warwick	35	0	0
	,,	Rugby	15	0	0
	,,	Merthyr	20	0	0
Potatoes	1869	Lodge Farm, Barking	33	0	0
	1870	,, ,,	25	0	0
	1871	,, ,,	18	0	0
Orions	1869	Lodge Farm, Barking	38	0	0
	1870	,, ,,	62	0	0
	1871	,, ,,	104	0	0
	,,	Warwick	35	0	0

From these instances sufficient proof is afforded that, with one crop per annum of a kind that will yield largely to the application of sewage, and command a certain and ready sale in the neighbourhood, a sufficient return may be gained to pay a full rent for the land, and a halfpenny a ton for the sewage, besides affording a good profit after paying all outgoings in the shape of rates, taxes, hand and horse labour, repairs and restoration of implements, seeds, interest on capital, &c. It is true that crops as large and even larger than those grown with sewage have been produced by good farming without sewage, and there would be nothing to say specially in favour of irrigation, were it not that the *united* advantages of manure and water ensure crops year after year under every vicissitude of season, and allow of two crops being taken from the same land occasionally. From the experience gained in the cultivation of Italian rye-grass, it is found that it may be readily grown in excess of the demand for it in a green state, and that, as this description of grass is most difficult to convert into hay, it is desirable to limit its growth to a narrower space. It absorbs and appropriates, however, a larger proportion of sewage than any other description of crop, and it is only because it thus helps to swallow up sewage that it is continued to be grown by those who seek rather to get rid of the sewage than to make the most of it. That speciality loses its force directly a fair value is put on the sewage, or when sewage is applied to land which is itself capable of absorbing and cleansing it, as in such case the manurial matter is stored in the soil for use by following crops.

Return from Intermittent Filtration.—The acreage return to the cultivator from the growth of crops on land used for intermittent filtration will depend upon the extent to which the intermittent principle is extended. If several series of filtering beds are adopted, as I have advised in the case of several towns, among which I may mention Birmingham, where the Sewage Inquiry Committee have declared their intention to adopt it, the return will be found quite as great, if not greater than that to be obtained from irrigation; for with the land rendered actively absorbent by drainage and deep cultivation, and laid up in bouts or ridges, crops may be grown while the sewage is being applied without suffering from excess of wetness. By extending the filtering process from one series, as suggested by the Rivers Pollution Commissioners, to several series of areas, so as to give two or three years' rest from filtration, such lands become available for the growth of the greatest amount of vegetation that can be produced from the land; for with the sewage at command any amount of watering that the crops require can be obtained by diverting the sewage for a time from the filtering areas in use. At Merthyr, the money realised by the sale of crops, comprising various roots and cabbages, grown between the 14th of June and the 31st of August last, amounted, on an average, of a day's sale by auction, to £17 15s. per acre, while the crops which were sold afterwards realised upwards of £20 an acre. These figures will bear comparison with the returns from irrigation proper; and I may here state that although the works have been very costly, owing, in a great measure, to their being the first of the kind carried into execution, and in being themselves the result of Chancery proceedings, the chairman of the Board (Mr. William Jones, of Cyfarthfa), says in a letter to me that much as the land and works have cost, "the filtering areas may yet pay;" adding that "had we obtained the land at a fair agricultural value, and the works been executed at the cost they would now be executed for, with acquired experience, I have no hesitation in saying they would be a source of great profit to the ratepayers of this district." These figures and the chairman's opinion are encouraging, and show a fair prospect of profit, if the authorities who have charge of such works abstain from growing the more refined kinds of gardeners' crops, which involve expensive hand-labour, and which are dependent on very fickle markets for sale.

Many considerations lead to the conviction that it will seldom be within the power of the sewer authorities of towns to adopt the widest use of sewage, which would result in the provision of 1 acre for rather more than forty persons, if we adopt the rate I have before stated, of sixty-two persons to 1 acre, with an allowance of 50 per cent additional land for increasing population. With constantly arising opposition, based on a fear of a nuisance (which under proper management will not arise), the difficulty of obtaining land, and the high price to be paid for it, will always stand in the way of wide irrigation. To compensate for the limitation these obstacles will impose, it must not be forgotten that the produce of sewage farms loses much of its value directly it overreaches the home market, and with a large area used for irrigation in the neighbourhood of a town this may be easily done. Already we hear of the produce of the Warwick Sewage Farm being sent to Birmingham, and that of Romford to Liverpool, and various instances of a like kind might be mentioned. One great advantage in the adoption of intermittent filtration, in the shape of concentrated irrigation, is that a greater variety of crops may be grown, and the over-stocking of the market with vegetables avoided, inasmuch as by giving each series of filtering areas a rest of a year or two, the growth of cereals and other crops, which are not successfully grown by ordinary irrigation, would take their part in rotation, and thus dispose of those manurial elements which might otherwise be left in the soil.

It would be too sanguine a view to suppose that the ratepayers of a district adopting the filtration process in its narrowest form would receive as much for their sewage as when irrigation is adopted under advantageous circumstances in its widest form, but it is more than likely that, in a majority of cases, a better return may be gained from a medium course of action than from any other, though it is our duty, in a national point of view, to aim at making the most we can of the valuable matter with which we have to deal.

(To be continued.)

CORRESPONDENCE.

ERRORS IN TEXT-BOOKS: "FOWNES" ON VOLTAIC ELECTRICITY.

To the Editor of the Chemical News.

Sir,—I had written a few notes on the subject mentioned above, when I saw in the Chemical News (vol. xxiv., p. 227) a letter drawing attention to some errors in text-books very properly pointed out by Dr. Watts, and I was confirmed in my intention of sending them to you for publication for the reason mentioned at the close of the letter referred to—viz., that errors in text-books are undesirable.

My notes were to the following purpose:—

In a book so deservedly held in high estimation and so much used in chemical education as Fownes's "Elementary Chemistry," which is now in its tenth English edition, and is reprinted at this stage in the United States, it is most important that there should be no ambiguity even in its teaching, and yet it contains self-contradictions and statements so entirely at variance with accepted views concerning the voltaic pair that students cannot fail to be strangely puzzled on looking at its different pages, to say nothing of comparing these with those of other works.

At page 120 of the American edition, by Prof. Bridges, of Philadelphia, of the tenth English edition of "Fownes," we find, "zinc and platinum put into dilute sulphuric acid constitute an arrangement capable of generating electrical force; the zinc being the metal attacked becomes negative, and the platinum remaining unaltered assumes the positive condition." On the opposite page we have—"The polarity or disturbance may be considered to commence at the surface of the metal attacked, and to be propagated through the liquid to the negative conductor, and thence back again by the connecting wire, these extremities of the battery being always respectively negative and positive when the apparatus is insulated. In common language it is said that the current in every active battery starts from the metal attacked, passes through the liquid to the second metal or conducting body, and returns by the wire; hence, in the pile and crown of cups, the current *in* the battery is always from the zinc to the copper, and *out* of the battery from the copper to the zinc, as shown by the arrows." Italics in the book.

At page 250 of the same, in reference to the crucial experiment by which Faraday proved that contact of dissimilar metals is not essential to cause currents, the iodine is said to be separated "beneath the extremity of the platinum wire—that is at the positive *side* of the arrangement." The italics are mine. At the same page we find—"A strong argument in favour of the chemical view is founded on the easily proved fact that the direction of the current is determined by the kind of action upon the metals, the one least attacked being always positive. Let two polished plates, the one iron and the other copper, be connected by wires with a galvanometer, and then immersed in a solution of an alkaline sulphide. The needle in a moment indicates a powerful current, passing from the copper through the liquid to the iron, and back again through the wire. Let the plates be now removed, cleaned, and plunged into dilute acid; the needle is again driven round, but in the opposite direction, the current now passing from the iron through the liquid to the copper. In the first instance the copper is acted upon, and not the iron. In the second, these conditions are reversed, and with them the direction of the current." In the third paragraph from this we learn—"Thus, exactly the same effects are seen to occur in every active cell of a closed circuit that are witnessed in a portion of sulphuric acid undergoing electrolysis; oxygen appears at the positive side—with respect to the current—and hydrogen at the negative, but with this difference, that the oxygen instead of being free combines with the zinc."

Let us compare the clear statement of Miller (vol. i., p. 329, first edit.) with the foregoing:—"In all these cases the positive electricity sets out from the more oxidisable metal, which may be termed the positive or generating plate, and traverses the liquid towards the less oxidisable metal which forms the negative or conducting plate; from the conducting plate the force is transferred to the wire, and thence in turn to the generating plate; thus the circuit is completed." To this may be added No. 108 of Tyndall's "Notes on Electricity"—"The outer ends of two pieces of zinc and platinum partially immersed in acidulated water are in opposite electrical conditions. The free platinum end shows positive electricity, while the free zinc end shows negative electricity."

To revert to "Fownes:" at p. 251 of the edition cited, mention is made of the division of the elements by Berzelius into *electro-positives*, which, like hydrogen and the metals, move towards the negative pole of the battery, as if they were attracted by it, and the *electro-negatives*, which like oxygen, chlorine, and bromine, move towards the positive pole. Presently we find—"Still it is true in a general way that those elements which differ most strongly in their electrical characters, chlorine and potassium for example, are likewise those which combine together with the greatest energy, and the division of bodies into electro-positive and electro-negative is therefore retained; the former are also called *acid* or *chlorous*, and the latter *basylous* or *zincous*." The italics are in the book.

If the obvious confusion in "Fownes" were in a first edition some excuse might be made, but surely it is too much to allow in a book which has passed through so many editions, and through the hands of various editors of high representation. In the interests of teachers and students the necessary corrections ought to be made.

Our friends in the States are said to be fond of reversing the ways of the Old World, but I fancy theirs are rather social and political than scientific reversals, and, I think, you will find all I have pointed out to be also in the English editions. The advertisements of the American publisher, dated May, 1869, says—"So recent and so thorough has been the revision which this work has enjoyed at the hands of the English editors, that but little has remained to be done in preparing the present reprint." It then goes on to state that attention has been directed to secure the accuracy so essential to a treatise of this nature, and that especial care has been devoted to the formulæ.

Hoping that others will be at the trouble of pointing out "errors in text-books," and reminding students that the precept is still worth attention that each must be "Nullius addictus jurare in verba magistri."—I am, &c.,

Henry How.

Windsor, Nova Scotia,
Dec. 14, 1871.

MISCELLANEOUS.

The Royal Polytechnic.—As usual the Christmas programme of this Institution is attractive. It includes two entertainments by Professor Pepper, entitled "Shadows, and the Story of the Shadowless Man," and "The Battle of Dorking, answered by the Autumn Manœuvres." There is also a musical entertainment by Mr. George Buckland, written by the Chairman of the Institution, and other amusing novelties.

NOTES AND QUERIES.

Refining of Paraffin.—"M. P. S." will be glad to be informed, through the Chemical News, where he can find the most recent information on the refining of paraffin and paraffin oils.

Sulphur Estimation in Cast-Iron by Mr. A. H. Elliott's Method.—Will the author of this method kindly state whether he has compared the results obtained by this method with the results obtained by any other method or methods (of course, on the same sample of cast-iron)? Also, has he used it for the estimation of sulphur in white irons or in steels containing a large amount of combined carbon? If he knows of any special precautions that have to be taken other than those already published, will he kindly state them? I and a friend have tried this method on white irons or steels, and find that all the sulphur is not evolved as H_2S. My friend fused the residue left in the flask, using every precaution, and obtained a precipitate with $BaCl_2$. In making an estimation of titanium in iron, by dissolving with dilute HCl, separating graphite and SiO_2 from the residue, fusing this residue (together with a small precipitate obtained from the iron solution by an alkaline acetate) with $KHSO_4$, dissolving in cold H_2O, adding a little Na_2SO_3 to reduce the persulphate of iron, and boiling the dilute solution, I have obtained a precipitate, along with the TiO_2, of a blackish brown colour, which proves to be V; is this V_2O_4? Would *all* the V in the residue be obtained in solution by the above treatment, and would it all be precipitated by boiling long enough? If titanic oxide be dissolved by strong HCl in the presence of NaF, will any titanium pass off as fluoride?—S. Peters, Bay State Iron Works, South Boston, Massachusetts, U.S.

MEETINGS FOR THE WEEK.

Monday, Jan. 8th.—Royal Geographical, 8.30.
Tuesday 9th.—Royal Institution, 3. Dr. Tyndall, "On Ice, Water, Vapour, and Air."
—— Civil Engineers, 8.
—— Photographic, 8.
Wednesday, 10th.—Geological, 8.
Thursday, 11th.—Royal, 8.30.
—— Chemical, 8.
—— Royal Society Club, 6.
—— London Institution, 7 30.
Friday, 12th, Astronomical, 8.
—— Quekett Microscopical Club, 8.

THE

MANUFACTURE OF CHLORINE.

ALTHOUGH the development of the process for the Manufacture of Chlorine by means of oxides of manganese regenerated by means of magnesia, to which reference was made on this page some months ago, has been sorely delayed by serious ill-health on my part, I am nevertheless in a position to announce that that process, in a certain modified form which it has now assumed, has proved capable of yielding even more advantageous results than I formerly claimed for it. It will necessarily be yet some time before I can be able or free to supply working details. Meanwhile, I beg to report as follows :—

I. That the new form of process yields, in the free state, practically *all* the chlorine contained in the salt decomposed, being at about the rate of *a ton of bleaching-powder per fourteen hundredweights of salt.*

II. That, of the chlorine which it thus yields, a sufficient proportion to give a ton of bleaching-powder for about each thirty hundredweights of salt is ENTIRELY UNDILUTED, and therefore available for the manufacture of bleaching-powder in the chambers at present in use. This portion of the chlorine is generated in the ordinary (Weldon) stills, and is in precisely the same condition as that produced in my process as at present practised, or as that generated by means of native manganese.

III. That, while the remainder of the chlorine is *dilute*, it is not more so than that produced in any process yielding dilute chlorine only, and is free from carbonic acid, the sole diluent being nitrogen.

IV. That the process, in its new shape, is performed without blowing engines, and *without machinery of any kind*, by appliances already in use in every alkali-work, the only thing employed in it which has any "moving parts" being an ordinary liquor-pump.

The new form of process thus yields more *strong* chlorine, per given quantity of salt, than has ever hitherto been produced by any process whatever, and, in addition, yields the remainder of the chlorine in as good a state as the richest chlorine producible by any process which yields dilute chlorine only. While permitting the present production of bleaching-powder, per given quantity of salt, to be nearly *quadrupled*, it enables one-half of the quadrupled production to be made from undiluted chlorine, in such chambers as have been employed hitherto, and one-half of the chlorine to be generated in the present stills. Putting the whole cost of the process on the *strong* chlorine only, the cost of the latter, per ton of bleaching-powder, promises to be lower than it has ever been yet, the other half of the chlorine counting as not costing at all. Lastly, the special plant required for the new form of process is so simple and inexpensive, that the cost of a plant for any considerable production will probably not exceed £20 for each ton of bleaching-powder to be made by it per week.

WALTER WELDON.

OFFICES OF WELDON'S CHLORINE PROCESSES COMPANY, (LIMITED),
59, LINCOLN'S INN FIELDS, LONDON, W.C.

December 12th, 1871.

THE CHEMICAL NEWS.

Vol. XXV. No. 633.

THE ATTAINMENT OF UNIFORMITY IN BESSEMER STEEL.*

By Dr. THOMAS M. DROWN.

The means relied on to attain uniformity in Bessemer steel may be enumerated as follows:—

(1). The appearance of the flame.
(2). The appearance of the slag.
(3). The spectrum of the flame.
(4). Examination of the steel itself.

At present I wish briefly to bring forward a few considerations with reference to the last two mentioned, namely—the conditions favouring the employment of the spectroscope and examination of the steel.

From the amount of careful investigation which has been devoted to the examination of the Bessemer flame by the spectroscope, both on the part of scientists and practical metallurgists, one might reasonably expect some results definite and satisfactory in their nature, first, as regards the nature of the flame, and second, as to the practical value of the spectroscope as a guide in conducting the process. We find, in fact, however, that uncertainty and confusion still exist. In Germany, where this subject has received the greatest attention, it is now very generally conceded that manganese is the cause of the well-known groups of dark bands that characterise the Bessemer spectrum. Nor is it easy to see how we can avoid accepting this conclusion, when Wedding and Von Lichtenfels have produced the manganese spectrum and found it to correspond closely with that shown by the Bessemer flame.

But it is evident, on a moment's reflection, as Roscoe has recently brought forward, that manganese cannot be the only cause of the Bessemer spectrum, for we notice the characteristic bands quite as plainly when English pig-iron is blown, which does not, at the beginning of the operation contain as much manganese as the German pig-iron does when the blow is completed, and the dark bands have completely disappeared from the spectrum.

Roscoe considers the bands to be due to carbon, which is known under different circumstances to present different spectra. Whatever may be the truth of the matter, one thing is certain, that the disappearance of the lines from the spectrum is coincident or nearly so, with the disappearance of carbon from the iron.

The question of the practical use of the spectroscope in the Bessemer process is, however, fortunately independent of any theory that we may hold regarding the causation of the spectrum, although we must admit that the idea of the lines being caused by carbon or carbonic oxide, the disappearance of which from the spectrum, coincides with the disappearance of carbon from the iron, has in it something attractive, affording, as it does, a common standpoint for theory and practice.

It is solely to the practical side of the question that I wish to draw attention now, and endeavour to reconcile, if possible, the conflicting statements made regarding the value of the spectroscope as a guide for stopping the blow.

The clue to the difficulty is to be found, I think, in the fact that the reports from Germany are almost unanimous as regards the practical advantages to be derived from the use of the spectroscope, whereas in England it is looked upon mainly as an instrument of scientific interest, which although it indicates promptly when to stop blowing, yet is no more accurate in its indications than is the flame itself to the unaided eye of an experienced workman.

The most emphatic endorsement of spectroscopic observations of the Bessemer flame that we have noticed from England are the statements of Mr. Snelus of Dowlais and Mr. Bragge of Sheffield, both quoted by Mr. Roscoe in his paper on "Spectrum Analysis" recently read before the Iron and Steel Institute of England.

"Mr. Snelus has informed me," writes Mr. Roscoe, "of the result of a series of experiments which go to prove what appears to me to be a very important point, and that is this—not only does he agree with me in finding that the point of decarbonisation can be accurately reached by means of the spectroscope, but he believes that it is also possible at the beginning, or in the course of the blow, to predict how long the blow will last—that is to say, he predicts in the middle of a blow, that the blow is going to last, say, for 18 minutes; and he finds that it does actually last 18 minutes. He then predicts, in in another case, 24 to 25 minutes; and he finds that it really lasted 23½ minutes. He then predicts 32 minutes in another blow, and finds that it did take 32, and so on through thirty experiments, which were made both at Dowlais and Ebbw Vale."

When we consider that a few seconds more or less blowing materially affects the character of the steel produced, the practical advantage of the use of the spectroscope cannot be said to have received much support from these experiments, although in themselves of interest and value. The report of Mr. Bragge, also quoted by Mr. Roscoe, is to the effect that the spectroscope is daily used in the Atlas Works for determining the point of the disappearance of the carbon, and that, to a certain extent, they are satisfied with the result, especially in the case of new metal.

In Germany, on the other hand, as is well known, there are many Bessemer works where the spectroscope is relied on exclusively for stopping the blow. So plain are its indications found, that in Zwickau in Saxony, or instance, it is used by uneducated workmen with complete success.

That there must be a cause for the difference of opinion existing in England and Germany on this subject, independent of the love of the Germans for scientific research in practical matters on the one hand, and the excessive conservatism of the English in established manufactures on the other, must be conceded; for the practical failure of the spectroscope to aid the Bessemer process in England is the result of fair trial by scientific and practical men.

When one first observes the Bessemer practice in Germany, after being familiar with the English method, he is struck by the fact that the duration of the blow is much longer, as a rule, and the heat of the charge much greater.

The cause of the greater duration of the blow must be either that there is more to oxidise in the German pig-iron than in the English or that the rate of oxidation is slower. By comparing the two pig-irons we find that the English usually contains more silicon, the German more manganese, and also, as a rule, slightly more carbon, but the difference is not sufficiently great to account for any marked difference in the duration of the blows.

We must look for the cause, then, in a diminished rapidity of oxidation, which is dependent on the pressure of air and the number and diameter of the tuyeres. The pressure employed is very generally the same in all countries, as the height of the iron in the converter is generally uniform, but the number of tuyeres employed is very variable.

I regret that I have not been able to collect more data on the subject, but the following examples will, nevertheless, show clearly the difference of the English and German practice in this respect:—

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* A paper read before the American Institute of Mining Engineers.

	Capacity converter.	No. of tuyere holes.	Diameter.	Total area, in sq. in.
Konigshütte ..	3	49	$\frac{1}{4}$ in.	2·40
Neuberg.. ..	3	49	$\frac{1}{3}$,,	4·27
Zwickau.. ..	3	42	$\frac{2}{5}$,,	5·12
Heft	2	42	$\frac{1}{3}$,,	3·66
Crewe	5	144	$\frac{3}{8}$,,	15·59
Dowlais	5	156	$\frac{3}{8}$,,	17·22

If we reduce the number of square inches in each instance to the standard of 1 ton capacity, we have for

Königshütte	0·80
Neuberg	1·43
Zwickau	1·71
Heft	1·83
Crewe	3·18
Dowlais	3·44

At Harrisburg and Troy, we have 120 tuyere-holes of $\frac{3}{8}$ in. in 5-ton converters, making a total area of 13·25 square inches, or 2·65 per ton capacity, which is about a mean between the German and English practice.

From these examples it will be seen that the relative amount of air forced into the converter in England is nearly double what it is in Germany, and we can thus see why it is that the duration of the blow should be so much longer in the latter country. What may have been the original cause of the adoption of a smaller number of tuyeres in Germany I do not know, but that this fact has an important bearing on the use of the spectroscope will be evident on a moment's consideration. The spectroscopic indication of the complete decarbonisation of the iron is the disappearance of the characteristic lines from the spectrum. If, in the last stage of the process, the oxidation of the carbon is effected very rapidly, as in England, the disappearance of these lines may be almost instantaneous, and afford no better indication to the conclusion of the blow than the dropping of the flame, with which it is coincident. If, on the contrary, the oxidation proceeds comparatively slowly, as in Germany, the lines fade away gradually, and it is from the degree of distinctness of the lines that the degree of decarbonisation is judged.

It requires but comparatively little experience to enable one to estimate, with very great nicety, the extent of the decarbonisation by the degree of distinctness of the characteristic bands in the spectrum. Although a practised eye will often unaided be as correct in its decision as one provided with a spectroscope, yet, in the long run, there can be no doubt that greater accuracy and simplicity of working is attained by relying exclusively on the indications of the spectrum, provided that the rate of oxidation is not too rapid.

The employment of an excessive number of tuyeres prevents, too, the nice adjustment of the amount of air to the amount of carbon and silicon towards the end of the process. It is readily conceivable that when the amount of these elements remaining is very small, that they may not be able to preserve the iron from oxidation in presence of a large amount of air.

Whether the heat of the charge has anything to do with the reliability of the spectroscopic indications cannot be definitely stated, but it seems reasonable to suppose that the higher the temperature the more satisfactory the observations will be. The only evidence bearing on this point is from Bleichsteiner of the Maximillian's Hütte in Bavaria, who has observed that with hot charges, with much smoke, which accompanies highly manganiferous pig-iron, the Bessemer spectrum disappeared before the complete decarbonisation of the iron had taken place, whereas with cold and non-smoking charges the disappearance of the spectrum and complete decarbonisation were coincident.

I have already mentioned the fact, which I think, will be generally admitted by those conversant with the subject, that the heat of the charge is, as a rule, greater in the German practice than in the English. This fact I have noticed particularly at Zwickau, where the flame in the last stage of the blow is so intensely bright that coloured glasses are almost indispensable to protect the eyes. The cause of the higher temperature attained in Germany is somewhat obscure.

In general, the sources of heat in the Bessemer process may be enumerated as:

(1). The initial heat of the metal in the converter, which depends on the temperature of the pig-iron as it flows from the cupola, and the temperature of the converter.

(2). The heat resulting from oxidation of the silicon, which is equal, according to Jordan, to 6382·4 units for every kilogramme oxidised by atmospheric air to silicic acid.

(3). The oxidation of iron, equal to 757 units per kilogramme of iron oxidised to protoxide.

(4). The oxidation of manganese to protoxide, equal, according to Jordan, probably to the same amount as in case of iron.

(5). The oxidation of carbon to carbonic oxide, in which case only 475·2 units are available in the process per kilogramme of carbon.

The main source of the increase of heat during the process is due, therefore, to the oxidation of silicon, which is much more largely present in English pig than in the German. Not much influence can be attributed to the manganese, as it merely replaces iron in the slag, and as we have assumed the thermic effects of the oxidation of manganese and iron to be equal.

I have thought that it might be possible in those instances where the English practice is followed of blowing with a large number of tuyeres, that some air might pass through without having all its oxygen absorbed. When we consider that the depth of iron in the converter would be only 12 to 14 inches in height, were it in a state of rest, and that it is tossed about by a current of air with such violence as to be often ejected in part from the mouth of the converter, such a condition of affairs seems not improbable. If it is ever actually the case, a loss of heat would, of course, be the consequence.

The only experiments which bear on this point, as far as I know, namely those of Snelus of Dowlais, do not, however, support this view. He examined the gases evolved from the converter during a blow of 18 minutes at 2, 4, 6, 10, and 12 minutes after the commencement, and found no free oxygen present, showing that it had been completely absorbed.

But as the experiment was not tried primarily with a view of determining this point, it may be that the conditions with reference to pressure and amount of blast were not as we have supposed.

The more rapidly the oxidation proceeds, other things being equal, the higher, of course, will be the resulting temperature. If it should be proved, therefore, that the limit of tuyere area has not been exceeded, and that the oxygen of the blast is completely absorbed even in the extreme cases which have been mentioned, then the English practice of blowing ought to be more favourable to the production of a high temperature than the German.

Apart from these considerations, it is undeniably true, that there are many great advantages resulting from a very high temperature in the converter, one of the most important of which is the opportunity afforded for testing the steel before casting. In spite of accumulated experience gained in conducting the Bessemer process, in spite, moreover, of the great assistance we may derive from the use of the spectroscope, it must, nevertheless, be admitted that absolute certainty with regard to the quality to the steel produced can only be gained by examining the steel itself.

In Zwickau, where the process is performed without the usual addition of spiegeleisen or other form of pig-iron, the blow is suspended when the spectrum indicates that the decarbonisation is sufficiently complete. A long rod of iron is then inserted into the converter, to which a quantity of slag adheres, through which are dispersed beads of metal. The rod, after removal, is at once plunged into water and allowed to remain till cold. The metallic beads are then separated from the slag and tested by hammering as to their hardness and malleability. According as the result of this test is satisfactory or otherwise, the steel is poured into the ladle, when sufficiently cool, or the converter is turned up again and the blast continued for a second or two longer. By this system perfect uniformity of product is obtained.

That this result is rendered possible by having a temperature in the converter much higher than is simply necessary for casting, shows the practical value of high heats. Whether the advantage of uniformity of product would be considered more than counterbalanced by the shorter duration of the converter lining, is a matter to be determined from an economical standpoint, which it is not my purpose at present to discuss.—*Engineering and Mining Journal.*

SEWAGE AS A FERTILISER OF LAND, AND LAND AS A PURIFIER OF SEWAGE.*

By J. BAILEY DENTON, C.E., F.G.S.,
Hon. Member of the Royal Agricultural Societies of Norway, Sweden, and Hanover.

(Concluded from p. 9).

III. *Separation of the Excretal Closet-matter from the Liquid Refuse of the Sewer, and dealing with each separately.*

As already stated, the treatment of the excremental contents of the closet separately from the liquid sewage of the sewers, is an object in which agriculturists must take a very great interest, though I have never yet met with any estimate of their value. Reverting, however, to the figures given as the value of the voidings of human beings, it would not be too much to take a fifth of the intrinsic value quoted (8s. 5¾d.), or 1s. 8½d. per head of the population, as the value of that which is retained in the closet, and which is capable of separate treatment, and is easy of removal to lands which cannot partake of the liquid sewage.

As the subject of this paper is limited to the fertilising powers of sewage and the purifying powers of soil, it forms no part of my purpose to discuss the question whether town authorities act wisely in maintaining such a species of scavenging as is involved in the removal of the excretal refuse apart from the liquid sewage. I am however, prepared to state that, having examined several dry processes now in use, there are some that may be adopted without objection, though it cannot be expected that the occupiers of superior houses who have once enjoyed the comfort of well-supplied and well-constructed water-closets should abandon the advantage and resort to dry closets of any description. At Rochdale, Alderman Taylor has patented a plan which is now in use there. Beneath each seat a receptacle containing a small quantity of a disinfecting fluid is placed, in which the fæces and urine are collected. The receptacles are removed in a covered cart weekly, or more frequently if required, to a manufactory on the outskirts of the town. There they are mixed with fine ash reduced from the cinders and dry refuse collected from the houses. The larger cinders, when separated from the ash, are sold. The average price realised for the manure mixture has been 17s. per ton, affording a profit, after deducting all expenses, of 2s. 5d. per ton. At the price mentioned, the manure is readily sold, and I can well believe is of great value to the farmer, particularly for certain descriptions of grass lands.

In large manufacturing towns, where water is much required in the trade that supports the population, and where it is desirable to economise as much as possible its use, and therefore to avoid water-closets, Alderman Taylor's process has much to recommend it, and from personal observation I am able to declare that it is free from the many objections that attend badly-constructed and badly-managed water-closets. In fact, I examined many closets attached to cottages in Rochdale which were much more creditable than many of the water-closets attached to large establishments in the metropolis.

But whatever may be done with the excretal matter by dry appliances, it will not be possible to avoid the proper disposal of the sewage of the sewers, and that will still have to be done by one of the classes of treatment already explained.

In small towns and villages it is still to be hoped that the dry-earth system, invented by the Rev. Henry Moule, may be more generally adopted. The experience gained, however, shows that the frequency with which the closets get out of order, and the difficulty of supplying and removing the earth is such that, unless a system of management is organised and enforced, they cannot gain much ground.* Where there exists a proper officer, with assistants, if necessary, to supply the earth and remove the soil, and to keep the closets in working order, it is impossible that anything can be more suitable for isolated establishments and country villages; and when it is remembered that the difficulties of providing a public supply of water to villages are such as to be insurmountable in many cases, and that the leaky condition of the privy and cesspit maintains the soil in close villages in an excrement-sodden condition, resulting in the pollution of tank or well water, it does appear almost incomprehensible that the governing powers of this country should permit the continuance of the present state of things.

Land as a Purifier of Sewage.

Having spoken of the general purification of sewage by land, when treating of irrigation and filtration, it is only necessary to add a brief description of the process of intermittent filtration, as it has been carried out under my directions at Merthyr-Tydfil. There 20 acres of land have been laid out for the purification of the sewage of the district, of which the dry weather flow at the time when the works were commenced amounted to 870,430 gallons per diem, the least flow during the day being 500 gallons; and the greatest 663 gallons a minute. The population contributing this sewage exceeds 50,000, but at present less than half the houses are connected with the sewers so that the sewage may be taken as equivalent to the discharge of about 30,000 people. The number of water-closets being few, the sewage may be considered to be weak. Upon occasions of rainfall (which is above the average), the flow of the sewers is much increased, the storm waters frequently raising the discharge at least 50 per cent above the ordinary dry weather flow, and this excess finds its way to the filtering areas. The 20 acres of land were divided into four equal parts, and before forming the surface to receive the sewage the whole was drained from 5½ to 7½ feet deep, and deeply cultivated. By this means 2 cubic yards of soil for every square yard of surface became serviceable as filtering material, there being but very few rods of ground in which the full depth of 6 feet was not secured. The quantity of filtering material was fixed upon so that the maximum quantity of sewage which

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* Read before the Society of Arts, December 6, 1871.

* For description of a means of dealing with slop and scullery refuse by Field's self-acting syphon, see "Village Sanitary Economy," in the *Journal of the Royal Agricultural Society*, vol. iv., s.s. part 1.

would at any time have to pass through each cubic yard of soil would not exceed 7½ gallons per diem, while the mean quantity of dry weather sewage would pass through at the rate of 5 gallons per cubic yard. The under-drainage was so designed that no sewage could travel over the surface directly above the drain, which is the case in instances of irrigation of free soils in which the results have not been so favourable.

Here the result has been the most complete purification of the sewage up to this time, and the realisation of the fact that the effluent water from the under-drains was as pure when the whole of the sewage was passing through half the filtering areas, viz., 10 acres, as when it passed through 15 and 20 acres, showing clearly that a less number of acres than 20 acres would suffice for the purification of the quantity of sewage dealt with, and that, therefore, if the sewage had been double the strength or double the quantity, as it may ultimately be when the whole of the sewage of the 50,000 persons is discharged by the sewers, there will be a certainty of complete purification of the whole if the board manage the works efficiently now they are completed.

During the period when the existing sewage, increased at times by the rainfall, was discharged upon the 10 acres (half the areas), they were receiving as much as 144,000 gallons per acre, which is equal to a depth of nearly 6½ inches, and never less than 72,000 per acre (equal to a depth of 3¼ inches).

Instead of following the mode of distribution usually adopted in sewage irrigation, when the fluid is either run over a regular surface, or along the ridge to flow over the slopes on either side, the surface of the Merthyr filtering areas was laid out in the ridge and furrow form, as before explained, the object being to allow of the use of the horse and hand hoe, and while growing crops on the ridge to allow the sewage to flow in the furrows, and rise up to the ridge sides with a certainty of being absorbed, and of feeding vegetation at the same time. This treatment has been so successful that, in spite of the deposit of the finer particles of floating matter in the furrow, the whole of the sewage has disappeared within four or five hours after application, and the land has acted as a purifier up to this time in such a way that the effluent water from the under drains is pronounced by Dr. Benjamin Paul to be cleaner than the Thames water above the intakes of the metropolis water companies. In order that its condition may be compared with the standard suggested by the Rivers Pollution Commissioners, I here give the analyses of the discharge from the 10 and 15 acres, when the whole of the sewage was run through those quantities of soil:—

Results of Analyses in parts per 100,000.

Solid contents—

	Effluent water from 10 acres.	Effluent water. from 15 acres.
Total	39·000	55·000
Fixed	34·000	34·000
Volatile..	5·000	21·000
Ammonia	0·082	0·086
Organic matter ..	0·018	0·011

Though it is a subject of personal satisfaction to me to have been the first to test, by designed operations, the process of intermittent downward filtration, suggested by the Rivers Pollution Commissioners, and to prove by direct evidence that the objections they anticipated can be avoided, the result might have been expected from the circumstance that in every case where sewage has been utilised on land, and allowed to pass through the soil as well as over it, the effluent water has been perfectly satisfactory. This will be seen by the following analyses of effluent water discharged from lands which have absorbed the sewage without any overflow from the surface, and without being laid out for intermittent action, except in the case of Merthyr Tydfil which I have described.

Parts per 100,000.

Date.	Place.	Total Solid Matter in solution.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Chemical authority.
1868						
Sept. 10	Bedford.. ..	76·80	0·575	0·163	0·023	Rivers Pollution Commissioners.
,, 23	Carlisle	28·80	0·591	0·204	0·025	,,
,, 24	Penrith	21·90	0·320	0·108	0·001	,,
1870						
July 9	Convalescent Hospital, Walton	10·87	—	0·002	0·002	Dr. Odling.
July 24	Breton's Farm, Romford	70·60	—	0·037	0·003	Dr. Russell.
1871						
Sept. 4	Merthyr-Tydfil	39·00	—	0·018	0·082	Dr. Benj. Paul.
,, 4	Lodge Farm, Barking	91·30	0·676	0·198	0·005	Dr. Frankland
,, 12	Tunbr. Wells	34·44	—	0·060	0·030	Dr. Voelcker.

If the proportions of polluting matter indicated in these analyses are compared with those contained in the effluent liquid discharged from the chemical processes to which reference has been made, or even with those of the effluents from the surface of lands over which sewage has been passed, the superiority of the combined effect of filtration associated with irrigation must be acknowledged. And on a study of all the facts such comparisons will expose, it will be manifest to every unprejudiced mind that not only is it possible for town authorities to conform to a high standard of purity, but that, with a comparatively small quantity of land at command, it is a simple and inexpensive thing to do.

If this be true, ought there to be any hesitation in adopting a standard so high as to remove all doubt on the subject, with compulsory powers to enforce it?

We have had mournful proof that polluted water will find its way into the palace of the powerful as well as into the cottage of the poor; and our Society has special reasons, in the very serious illness of our Royal President, the Prince of Wales, which has aroused the anxiety of the whole nation, and which is said to be traceable to impure water or sewer gases, for exerting all the power it possesses in preventing the public interests being sacrificed to the influence of water companies, and the false notions of economy which prevail with Local Boards of Health.

EXAMPLES FOR PRACTICE IN QUANTITATIVE ANALYSIS.

By ALEXIS A. JULIEN,
Assistant in charge of the Quantitative Laboratory of the School of Mines, Columbia College.

(Continued from vol. xxiv., p. 295).

Example No. 11.—*Proximate Analysis of Coal.*

Pulverise sufficiently fine to pass through a sieve of 100 holes to the linear inch.

(*a*). Weigh out 1 grm. of coal in a half-ounce platinum crucible, heat fifteen minutes in an air-bath at 115° C., cool, and weigh. Repeat the operation at intervals of ten minutes in the air-bath, until the weight becomes constant or begins to rise. The loss, obtained from the lowest weight, is equivalent to the moisture. But if the coal is an anthracite, or if, by a preliminary experiment, it has been ascertained that more than an hour is necessary to obtain the lowest weight, much longer intervals may be substituted for those given above.

Immediately heat the same crucible, covered closely, to bright redness over a Bunsen burner for exactly three and a half minutes; and then (without cooling or moving the crucible) to a white-heat over a blast-lamp, for three and a half minutes; cool, and weigh. The loss is equivalent to the volatile and combustible matter, including one-half of the sulphur of the FeS_2 which the coal may contain. Repeat the operation on another grm. of coal (previously removing the moisture), and if the results agree within one-tenth of a per cent, take the mean.

Remove the cover, incline the crucible, and ignite over a Bunsen burner until all the carbon is burned off, as determined by the colour of the ash and the constant weight. The loss is equivalent to the fixed carbon, and the weight of the last residue is that of the ash. The latter may also be directly determined by igniting another portion of the original coal in an open platinum capsule, previously weighed.

A qualitative examination of the ash for iron, sulphur, phosphorus, &c., is generally sufficient, but, if a quantitative is desired, it may be fused with Na_2CO_3 and then analysed as in Example No. 7.

(*b*). *Determination of* S *and* P.

Put 2 to 5 grms. in a covered vessel of the capacity of at least one litre; add about 100 c.c. of conc. HNO_3 (sp. gr. about 1·3), and 5 grms. of powdered $KClO_3$; and heat to boiling, replacing the HNO_3 as it evaporates, and adding lumps of $KClO_3$ from time to time (to keep the vessel full of chlorine) until all the carbon is oxidised. Transfer to an evaporating dish, evaporate to dryness to separate the SiO_2, moisten with HCl, dilute, filter, and wash, heat the filtrate to boiling, add $BaCl_2$ in excess, and determine the S as $BaSO_4$ in the usual way, thoroughly purifying it after ignition.

To determine the P in the coal, unite the filtrate and washings from the $BaSO_4$ obtained above, heat to boiling, add $(NH_4)_2O$ in excess, filter rapidly, wash once, dissolve in HNO_3, and precipitate the P with ammonic molybdate. Or twice as much coal may be dissolved at first, the HNO_3 solution divided, and the P precipitated directly in one-half.

The coal may also be decomposed by the following method. Mix 2 grms. thoroughly with 16 grms of Na_2CO_3, and 16 grms. of Na_2NO_3, all in fine powder. Deflagrate in a covered two-ounce platinum crucible; cool, dissolve in water, and remove the crucible; acidulate; transfer to evaporating dish, and proceed as above.

(*c*). *Determination of Specific Gravity*.—Pulverise to small fragments which will just pass through a sieve of 30 holes to the linear inch, and free from any finer powder. Introduce into a flask with tubulated stopper, allow to soak in distilled water for 12 hours, and determine the specific gravity in the usual manner.

Example No. 12.—*Determination of Nickel in Ores.*

Digest from 3 to 5 grms. of finely powdered ore with 20 c.c. H_2SO_4, 10 c.c. HNO_3, and 5 c.c. HCl. Evaporate to dryness, expelling the excess of H_2SO_4, cool, moisten with HCl, add hot water, filter, and wash. Saturate the diluted filtrate with H_2S gas, filter out the sulphides of copper, lead, &c., and wash with H_2S water. Boil the filtrate with a little HNO, add Na_2CO_3 almost to neutralisation, and precipitate the Fe_2O_3 and Al_2O_3 as basic acetates, as in the analysis of iron ore, filter, and wash. Dissolve the basic acetates in HCl, and repeat the precipitation, filtration, and washing, to separate a little NI at first carried down. Unite and concentrate all the filtrates and washings, and add $(NH_4)_2O$ in excess. If a little Fe_2O_3 separates, filter, wash twice, dissolve in HCl, re-precipitate with $(NH_4)_2O$, filter, wash, and add the filtrate to the main solution. Boil, add a boiling solution of NaS in excess, acidulate with acetic acid, allow to settle, filter, wash the NiS with H_2S water, remove the moist precipitate as completely as possible to an evaporating dish, dry and burn the filter; dry and roast the precipitate in the dish, and add the ashes of the filter. Dissolve the whole in a little aqua regia, evaporate the free acid almost entirely, dissolve in hot water, boil, add pure solution of KHO in slight excess, heat for some time nearly to ebullition, decant upon a filter three or four times, boiling up each time, filter, wash thoroughly with hot water, dry, ignite, and weigh. Carefully examine the residue for KO,SiO_2, Fe_2O_3, and Al_2O_3, and CoO. Result—NiO+CoO.

In American ores, the metal in this residue rarely exceeds 1 per cent of the original ore, and the Co is seldom separated; but, if desired, the following method may be employed:—

Dissolve the residue in a few drops of HNO_3, and neutralise the excess of free acid with a few drops of KHO. Then add a concentrated solution of KNO_2 (previously neutralised with acetic acid and filtered from any flocks of SiO_2 and Al_2O_2 that may have separated) in sufficient quantity, and finally acetic acid, till any flocculent precipitate that may have formed from excess of KHO has re-dissolved and the fluid is decidedly acid. Allow it to stand at least for 24 hours in a warm place, take out a portion of the supernatant fluid with a pipette, mix it with more KNO_2, and observe whether a further precipitation takes place in this after long standing. If so, return it to the principal solution, add more KNO_2, and repeat the test after long standing. Filter, wash thoroughly with an aqueous solution of neutral potassic acetate (containing 10 per cent of the salt), and finally with spirit of wine of 80 per cent. Dry, ignite, incinerate the filter, moisten the whole with H_2SO_4, and drive off the excess and weigh. Result—$2CoSO_4+3KSO_4$.

Example No. 13.—*Determination of Zn in Blende.*

Treat 2 grms. of finely-powdered ore with 10 c.c. HCl, 5 c.c. HNO_3, and 5 c.c. H_2SO_4. Evaporate to dryness, and heat for some time after the fumes of H_2SO_4 have ceased. Treat with hot water, filter, and wash. Add 20 c.c. of HCl to the filtrate, saturate with H_2S gas, filter rapidly on a covered funnel, and wash with H_2S water. If the precipitate is bulky, dry, roast, dissolve in a little aqua regia (A, β), evaporate nearly to dryness, add water and HCl, saturate again with H_2S gas, and filter and wash as above. Unite all these filtrates and washings containing Zn, add Na_2CO_3 almost to neutralisation, and separate the Fe_2O_3 and Al_2O_3 as basic acetates. Redissolve and re-precipitate this precipitate, to obtain the portion of Zn at first carried down. Unite the filtrates and washings, acidulate with acetic acid, saturate with H_2S gas, filter, and wash with H_2S water. Treat with HCl, add a little $KClO_3$, boil, and filter into a capacious dish. Add solution of Na_2CO_3 in slight excess, boil a few minutes, allow to subside, decant upon a filter, wash by decantation several times, transfer to the filter, wash thoroughly, dry, remove as completely as possible from the filter, burn the filter on the lid, ignite, and weigh. Examine the residue for NaO, Fe_2O_3, and Al_2O_3. and SiO_2. Result—ZnO.

Correction.—In the Chemical News, vol. xxiv., p. 294, Note 18, for "Put solution (d_2) directly into," read "Expel HNO_3 from solution (d_2) by evaporation with an excess of H_2SO_4, and place in."

(To be continued).

FIBRIN: ITS ORIGIN AND SOURCES OF DEVELOPMENT IN THE ANIMAL ORGANISM;

VERITABLE FIBRIN BEING PROVED TO BE DERIVED FROM ALBUMINOUS SUBSTANCES BY THE AGENCY OF WATER.

By JOHN GOODMAN, M.D., &c.

(Concluded from p. 6).

Other Modes by which Fibrin is said to have been Produced.

I find that many physiologists who have been reputed to have produced fibrin by other agencies have done so out of dilute solutions, that is, under the influence and agency of water.

Thus Müller produced coagulated fibrin out of clear, filtered, and consequently defibrinated, blood serum. This experiment is graphic of what we have witnessed again and again in these researches. "But," says he, "the blood was diluted with water or with a very thin syrup, 1 part sugar in 200 water." In a few minutes a coagulum formed in the clear liquid after it had passed the filter. But, even then, "this coagulum could not be detected save by drawing it out of the fluid by a needle." "This," says he, "gradually (after a few minutes) contracts, becomes whitish and fibrous, and then has exactly the aspect of human lymph." As regards the admixture of two (diseased) serous fluids, such as those of hydrocele and ascites, or ascites and pleurisy, as suggested by Dr. Buchanan,* these could take no part in the mode of transformation of albumen into fibrin, in the absorbments, &c., and are therefore foreign to our present subject.

Finally, as regards the renowned experiment of Prof. Schmidt, who is declared by Dr. Carpenter to have attempted to explain the phenomena in question (p. 242), by attributing them to the combination of two substances, existing in the liquor sanguinis, which he has denominated "globulin" and "fibrinogen." That such substances really do always exist in the serum or liquor sanguinis, without Prof. Schmidt's interference, is not quite certain, any more than that of Mulder's favourite idea of protein existing ready formed in all nitrogenous substances as their primary and basic compound. However, Dr. Carpenter goes on to say, "Both Schmidt and Hoppe Seyler have been successful in producing a coagulum differing in no respect from ordinary fibrin, by the admixture of these two substances." One might have some difficulty and trepidation in assailing such an explanation of the origin of fibrin in the animal organism as the above, and by so eminent a physiologist, were it not for the great uncertainty that attends all speculations upon matters formed out of the body by chemical decomposition. But when we read on a little further, that both these compounds were precipitated by carbonic acid from dilute solutions, all difficulty is at an end. A good deal of water must have been employed, and, according to the facts of this paper, the *rationale* is obvious.

It is thus seen that many physiologists, in experimenting upon, and endeavouring to discover the origin and source of, fibrin in the animal organism, whilst employing other measures which they have supposed capable of effecting this transformation, have been unsuspectingly making use of the very agent which alone is capable of developing this important product.

It is rather remarkable how much the illustrious Liebig insists upon the necessity for the presence of water, before oxygen can effect any change in organic substances. ("Organic Chemistry," pp. 111 and 225).

Müller, in his work on Physiology (p. 294), declares that when frogs have been kept out of water for eight or more days, during the summer, their blood often loses the power of coagulation, and, under such circumstances, the lymph taken from the lymph cavities of the same animal affords no coagulum.

Fibrin is formed, therefore, as shown by Dr. Carpenter and other physiologists, in the lymphatics, lacteals, absorbent and mesenteric glands, and vascular system,† and we maintain, from the foregoing facts, that this transformation is effected by the agency of water. That water is drawn from the sanguineous circulation—the great cavities of the body, &c., and from the skin—is admitted by all physiologists, while at the same time the liquor sanguinis and albuminous substances are brought up from the blood-vessels and from the parenchyma of other organs, the latter in the shape of effete matters and used-up materials, which, as Dr. Carpenter says, are capable of being again assimilated; that these, on meeting with the aqueous fluids, begin at once to undergo a change, and that change is the transformation from albumen to fibrin, which he represents as the being subjected to an elaborating or preparatory agency previous to their introduction again into the circulation. This elaboration he speaks of again as being the formation of fibrin, the assumption of coagulation, and the appearance of a number of chyle or cytoid corpuscles. This process Dr. Prout speaks of as "a sort of digestion carried on in all parts of the body.

We observe, likewise, that the aliment itself is exposed to the action of water, in the shape of all fluids that enter the alimentary canal by imbibition, and afterwards the venous blood in the liver and vena cava is also subject to an influx of water, which is drawn from the stomach by the gastric veins.

Here, then, is the admitted presence of the transforming agent at the very point or locality—*i. e.*, in the lymphatic vessels and glands—where the presence of fibrin is first detected. The existing estimated amount, therefore, of this fluid in the lacteals and lymphatics, in comparison with the amount of existing albumen, and, at the same time, in comparison with the relative quantities of water and albumen in the blood, becomes an important subject of enquiry in this place.

According to Von Gorup-Besanez (Dr. Carpenter's "Physiology," p. 56), we have in 1000 parts of—

Lymph	albumen	24·6
Chyle	,,	40·9
Blood	,,	195·6

thus giving eight times as much water present in lymph, and five times as much in chyle, to 1 part of albumen, as is present in the blood.

According to Gubler and Quevenne, quoted by Dr. Carpenter (p. 178), we have in 1000 parts—

	Water.	Albumen.
Lymph	939·87	42·75
Chyle	904·80	70·80
Blood	796·93	58·82

thus presenting nearly 22 parts of water to 1 of albumen in lymph,—to 13½ water to 1 of albumen in the blood. In the chyle we have a higher amount of albumen in man, though not in animals, so it is stated, to the existing amount of water. But it must be remembered that this fluid had not as yet joined the lymph, being drawn for examination before it reached the receptaculum chyli, in which the lymph unites with the chyle. Nor had it either been subjected to the action of the imbibed fluids from the gastric veins, to which it is, at least for a short time, exposed after its entrance into the sanguineous circulation.

Finally, in corroboration of the facts herein adduced, how powerfully expressive is the fact that, in embryonic life, the fœtus is found to exist in an aqueous fluid, the liquor amnii, the composition of which is declared to be only 7 parts of albumen in 1000 parts of liquid,—a fluid to which both the alimentary canal and absorbent system through the skin have a free and constant access.

If water, therefore, is capable of producing with such facility the change in question,—if this change is, as we have seen, incapable of being effected without the presence of water,—and if this fluid is also discovered to be present in the lymphatics and absorbent glands, where fibrin is first and chiefly discovered to receive its origin, and that in an amount ample and sufficient to meet every requirement of the organism,—unless some more probable cause can be discovered, we shall, of course, be under the necessity of admitting water to be the producing cause of this phenomenon.

We have in possession several specimens of this product preserved in spirit, which could not be distinguished from blood fibrin; others, the result of exposure to oxygen, to the voltaic current, and also of precipitation, which present incontrovertible evidence of the facts herein adduced.

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* Dr. Carpenter's "Physiology," p. 242.

† *Ibid.*, pp 179, 180.

CHIEF CHEMICAL EXPERIMENTAL PROOFS.

Solution in Liquor Potassæ, cold.

Expt. 9.

Nov. 15. Fibrin *ab* albumen completely disappeared, or dissolved, in liq. potassæ, in about 3 minutes.

Expt. 19,

Nov. 17. The experiment repeated. It dissolved completely in a few minutes, without change of colour.

N.B. Much depends upon the thin membrane-like nature or thickness of the substance operated upon, for speedy solution or otherwise.

Expt. 66.

Dec. 8. Blood fibrin submitted to liq. potassæ required 12 hours for its solution in the same liquid, cold. It became reddish-brown before its solution was effected.

In this experiment blood fibrin resembled albumen much more nearly than did fibrin *ab* albumen.

Expt. 67.

Nov. 16. Albumen, coagulated by heat from the egg, required 24 hours for its solution in liq. potassæ, in three experiments. When cut into thin shavings it was dissolved in 12 hours. In all instances it became brown or black, and blood-red when heat was applied in dissolving.

Solution in Strong Hydrochloric Acid, cold.

Expt. 52.

Dec. 8. Blood fibrin was placed in ditto.

Expt. 52.

Dec. 8. Fibrin *ab* albumen was placed in ditto, cold.

Dec. 9. Both were quite dissolved, not a particle remaining; the liquid having assumed, in both instances, a dark green colour, in 24 hours.

Expts. 13, 14, 15.

Fibrin *ab* albumen, in ditto, dissolved in 14 hours.

Expt. 53.

Dec. 14. Albumen coagulated by boiling, was placed in ditto, cold.

Dec. 15. Gas is being eliminated, the coagulum still undissolved.

Dec. 30. Still undissolved in 16 days. A portion must be dissolved, as the liquid is dark green. Probably some of the albumen is transformed into fibrin which would dissolve in 12 hours (see above).

Expt. 17.

Albumen, raw, ditto ditto, a portion quite undissolved in 23 days.

Expt. 52.

Dec. 30. Thin portions of coagulated albumen, in heated acid, became dissolved in less than 1 hour.

Solution in Dilute Hydrochloric Acid.

"Fibrin of muscle, after it has been well washed and pressed, to free it from soluble matters, is dissolved, more or less completely, by dilute hydrochloric acid, 1 part in 1000."—*Dr. Miller*, p. 808.

Expt. 10.

Nov. 16. Fibrin *ab* albumen, placed in dilute acid, 1 part in 10. The surface swelled up, and became semi-transparent for a given depth, as if about to dissolve. But it was not before Nov. 24th, or eight days afterwards, that its solution had taken place. Fluid dark green.

Nov. 16. "Blood fibrin placed in water mixed with $\frac{1}{10}$th of its bulk of acid, swells up slowly into a gelatinous mass; on addition of a stronger acid, shrinks to nearly its original volume, and again swells up when put into water, but it does not form a true solution."—*Dr. Miller*, part 3, p. 808.

Expt. 55.

Blood fibrin in ditto unchanged in 6 days.

Expt. 12.

Nov. 16. Raw egg albumen was placed in ditto, 1 part in 10. It eliminated gas, and became quite dissolved by Nov. 21st, or in 5 days. Fluid dark green.

Precipitated Solutions under the Microscope.

Solutions in Liquor Potassæ, precipitated by Acetic Acid.

Expt. 78.

Jan. 7. Blood fibrin, in liq. potassæ, 3 drops, precipitated by acetic acid, 1 drop.

Result:—No coagulum. All fibrinous rods and formations adherent one to another. All transparent! In this and several other instances there were apparently coagula until each was brought into focus of the microscope, when they were seen as above.

Expt. 79.

Jan. 7. Fibrin *ab* albumen, in liq. potassæ, 3 drops, precipitated by acetic acid, 1 drop.

Result:—No coagulum. All fibrinous formations, like those of blood fibrin, resembling leaves of a tree, adherent together generally by a rod through the whole, or a rod for a stem, and sometimes rods for branches.

Expt. 80.

Nov. 17. Albumen, in liq. potassæ, 3 drops, precipitated by acetic acid, 1 drop.

Result:—White homogeneous flocculi, easily separable; an incoherent mass, more like inorganic substance, without formation. Not a single fibrinous rod.

Expt. 80 *repeated.*

Nov. 24. Repeated the same experiment with albumen.

Result:—Nothing but a cloudy or flocculent precipitate. No rod or other fibrinous formation!

Solutions in Potash of Commerce, precipitated by Acetic Acid.

Expt. 33.

Nov. 30. Fibrin *ab* albumen, ditto, ditto.

Result :—Fibrinous rods in a clear liquid. No coagula.

Expt. 35.

Nov. 4. Coagulated ov-albumen, ditto, ditto.

Result :—A white cloudy and flocculent precipitate, mixed with crystals of acetate of potash. No rods. All coagula.

Solutions in Potash of Commerce, precipitated by Nitric Acid.

Expt. 33.

Nov. 30. Fibrin *ab* albumen, in ditto, ditto, precipitated by ditto.

Result :—Nothing observable of any moment but long fibrinous rods, some coiled, others straight or crooked, and for the most part transparent, not yellow.

Expt. 34.

Ov-albumen coagulated by heat, in ditto, ditto.

Result :—Flocculi or nebulæ of albumen, shapeless, homogeneous, and opaque, intermixed with crystals of nitrate of potash. Precipitate, lemon-yellow colour.

Solutions in Liquor Potassæ, precipitated by Nitric Acid.

Expt. 81.

Jan. 7. Blood fibrin. Solution 2 drops, acid ½ drop.

Results :—Exactly resembling those of fibrin *ab* albumen precipitated by acetic acid. No flocculi, but transparent formations like leaves of trees, with stems of fibrinous rods, and sometimes rods for branches, adherent and moving together in mass, evidently all possessing the same nature and character. Many rods. No lemon-yellow.

Expt. 82.

Fibrin *ab* albumen. Solution 3 drops, acid 1 drop.

Results :—No coagula. All transparent fibrinous formations, exactly resembling those of blood fibrin. No flocculi, no coagulum, many rods. No lemon-yellow precipitate.

Expt. 83.

Albumen. "Nitric acid with albumen, lemon-yellow precipitate."—*Dr. Miller*, part 3, page 801.

Results :—Much coagulum ! No rods ! Precipitate, lemon-yellow colour always.

N.B. When old solutions were employed there was much of the fibrinous character in the albuminous, and of the albuminous in the fibrinous, results.

Solutions in Strong Hydrochloric Acid, precipitated by Liquor Ammoniæ.

Expt. 57.

Dec. 10. Blood fibrin, in ditto, ditto.

Results :—Effervescence. A dense coagulum found to be crystals only, by microscope. Large pieces of organised formation intermingled with rods.

Expt. 87.

Jan. 3. Ditto, ditto. In 2 or 3 minutes.

Results :—No coagulum. Fibrinous rods and thick bundles of fibrils. The solution is old ; some coagula form afterwards.

Expt. 58.

Fibrin ab albumen, in ditto, ditto.

Results :—Effervescence. A seemingly dense coagulum resolved into crystals, by microscope. Large pieces of organised fibrin, exactly similar to those of blood fibrin.

Expt. 88.

Jan. 3. Ditto, ditto. In 2 or 3 minutes.

Results :—No coagulum. Very long and straight fibrinous rods. Old solution ; some coagula afterwards.

Expt. 59.

Dec. 12. Albumen, in ditto, ditto.

Results :—An old solution. Fibrinous rods, with dense flocculi.

Jan. 3. A fresh solution. Ditto, ditto.

Results :—An instant coagulum. Dense and flocculent ; not a single rod.

Solutions in Strong Hydrochloric Acid, precipitated by Liquor Potassæ.

Expt. 84.

Dec. 30. Blood fibrin. Ditto, ditto.

Results :—Rods forming at once. No coagulum. Many rods. Apparent flocculi, when brought into focus, possess form. Many short rods. See Fibrin *ab* albumen, which this exactly resembles.

Expt. 85.

Fibrin *ab* albumen Ditto, ditto. In 3 minutes.

Results :—No coagulum. Rods forming, placed between two watch-glasses, exhibit nothing but what is formative, chiefly rods, some in bundles; not the slightest coagulum.

Expt. 86.

Dec. 30. Ov-albumen. Fresh. Ditto, ditto.

Results :—Instant coagulum. Not a single rod. Coagulum dense brown and yellow, or stone-coloured. On January 2nd two slight rods have formed.

NB.—All these experiments were again and again repeated, with similar results.

PROCEEDINGS OF SOCIETIES.

GEOLOGICAL SOCIETY OF LONDON.

December 20th, 1871.

Joseph Prestwich, Esq., F.R.S., President, in the Chair.

The communications read included the following :—

A letter from G. Milner Stephen, Esq., F.G.S., to the late Sir Roderick Murchison, dated Sydney, October 5, 1871, announcing the discovery of a rich auriferous deposit on the banks of the river Bondé, on the N.E. coast of New Caledonia, and of a great deposit of tin ore in the district of New England, New South Wales. The gold in New Caledonia is found in drift, and there are indications of the near proximity of a quartz reef. The tin ore in New South Wales is said to be in "pepitas, crystals, and beds of conglomerate, especially in micaceous granite, more or less decomposed."

Mr. D. Forbes stated that in 1859 he had placed in his hands some specimens of granite from the district the discovery of tin in which was announced by Mr. Stephen, and that he found them to be perfectly identical with the stanniferous granites of Cornwall, Spain, Portugal, Bolivia, Peru, and Malacca, which he had also examined. These granites were all composed of white orthoclase felspar, colourless or black Muscovite mica, and quartz. He was not aware that tinstone (cassiterite or oxide of tin) occurred anywhere in rock of a different character. It was always accompanied by more or less of the native gold.

Mr. Pattison remarked that in many places where tin occurred it was not present in sufficient quantity to be remuneratively worked.

Mr. D. Forbes, in answer to a question from Professor Ramsay, stated that, as far as could be ascertained, the age of the stanniferous granites mentioned by him must be between the end of the silurian and the early part of the carboniferous period.

Prof. Ramsay would carry them down to the close of the carboniferous period, and would be contented to term them pre-permian.

"*Remarks on the Greenland Meteorites.*" By Prof. A. E. Nordenskjöld, For. Corr. G.S.

The author stated that the masses of meteoric iron brought from Greenland by the recent Swedish expedition seem to have formed the principal masses of an enormous meteoric fall of miocene date, extending over an area of some 200 miles. The iron appears to be free from silicates. Against its eruptive origin the author urges that when heated it evolves a great amount of gaseous matter, and that it contains imbedded particles of sulphide of iron, the mass itself being nearly free from sulphur. The masses are composed of meteoric nickeliferous cast- and wrought-iron, or of mixtures of the two; in the last case the Widmannstætten's figures are best developed. The author further noticed the various modes in which the iron occurs, viz.:—

(1). As meteorites.

(2). Filling cracks.

(3). As brecciiform stones cemented with oxide and silicate of iron.

(4). In grains disseminated in the basalt.

Mr. Roberts protested against the evolution of gaseous matter being considered as a proof of meteoric origin.

Professor Ramsay reiterated his previously expressed opinion that "the masses of iron might be of telluric origin."

MISCELLANEOUS.

University College.—At a session of Council on the 6th inst., Mr. J. Booth, C.B., in the chair, after the reading of the School Committee's Report, in which the Committee represented the urgent necessity of an extension of the school buildings in order to accommodate the rapidly increasing number of pupils, Mr. Samuel Sharpe, a member of the Council and of the Committee, announced his intention to present the College with the sum of £4000 as a contribution to the cost of the required buildings. The cordial thanks of the Council were at once voted to Mr. Sharpe for this most generous gift, the gratitude evoked by which was enhanced by the recollection of former liberal donations to the College from the same gentleman, who had previously given two sums of £1000 each to the School-Building Fund, £1000 to the Retired Professors' Fund, £600 to the Fine-Art Building Fund, and several other lesser sums for various college purposes. The College has recently received from another liberal friend, Mr. J. Pemberton Heywood, a donation of £1000 to the School-Building Fund, to which he had contributed a like sum a few years ago, besides £500 to the Fine-Art Building Fund. At the same session a communication was read from the late Mr. Felix Slade's executors, in which they stated that, having been informed that further assistance was needed to defray the cost of the Fine-Art Buildings at the college, and to provide casts and other appliances for the use of the students, they had determined to place in the hands of the Council the sum of £1600, to be applied for the purposes above mentioned. It may perhaps be remembered that about two years ago the executors gave to the College £5000 towards the Building Fund, in addition to the large endowments for the Slade Professorship and Scholarships founded at the College, in pursuance of the directions contained in Mr. Slade's will. The best thanks of the council were voted to Mr. Slade's executors for this further proof of the desire which they have on every occasion evinced to promote the interests of the Fine-Art Department of the College. A resolution was adopted at the same session to admit ladies attending the class of political economy to compete for the prizes and the Hume and Ricardo Scholarships, awarded for proficiency in that Science.

Oxidation of Carbon and Artificial Production of Aniline.—At the meeting of the chemical section of the German Association for the Advancement of Science, at Rostock, on the 18th of September, 1871, the President, Professor Schulze, read a paper, on the direct oxidation of carbon by means of permanganate of potash in an alkaline solution, which excited lively debate, and was justly regarded as one of the most important chemical discoveries of the year. In addition to copious quantities of oxalic acid and of other products not yet determined, the author obtained an acid to which he has given the name of anthraconic, and which he found to closely resemble mellitic acid in its properties. The experiment was repeated with charcoal purified in a stream of chlorine gas, also by calcining cream of tartar, by the reduction of carbonic acid with phosphorus, and from graphite. All of these varieties of carbon yielded analogous results. So great was the interest manifested in the announcement, that the leading chemists adjourned to the Professor's laboratory, there to repeat the tests and to examine into the nature of the incidental products. They soon came to the conclusion that the new body was identical with mellitic acid. By treating the anthraconic acid with caustic soda, benzole was produced, which was converted into nitrobenzole in the usual manner, and from this product aniline was manufactured. We have in this way the artificial production of aniline from charcoal, and are brought nearer to an explanation of the chemical properties of carbon and of important practical applications likely to grow out of such knowledge. It is another step in the distinguishing characteristic of modern research, namely, the synthetical method, or the building up of compounds from their constituent elements. It is easy to rend asunder and destroy, but to rebuild requires the application of the highest genius. The discovery of Professor Schulze is likely to prove of great importance, as soon as it is thoroughly understood and applied.—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Annalen der Chemie und Pharmacie, November, 1871.

This number contains the following original papers and memoirs:—

Anthracen Derivatives.—C. Graebe and C. Liebermann.—This very lengthy essay, containing the detailed account of the latest researches on this subject, is divided into the following sections:—Anthracen-carbonic acid, $C_{14}H_9,CO_2H$; salts of this acid; behaviour of anthrachinon with various reagents; action of chloride of phosphorus upon anthrachinon; conversion of anthrachinon into anthrahydrochinon; behaviour of anthrachinon with caustic potassa; anthrachinon-sulpho acids; anthrachinon-mono-sulpho acid—

$$C_{14}H_7(O_2)SO_3H;$$

salts of this acid; behaviour of this acid with hydrate of potassa anthrachinon-bisulpho acid, $C_{14}H_6(O_2)(SO_3H)_2$; salts of this acid;

its behaviour with caustic potassa; formation of anthrachinon-bisulpho acid from bibrom- and bichlor-anthraccn; oxyanthrachinon-sulpho acid, $C_{14}H_6(O_2)''(OH)(SO_3H)$; oxyanthrachinon, $C_{14}H_7(O_2)''OH$; behaviour of alizarin-sulpho acid with caustic potassa.

On some of the Nitrogen Compounds of Anthrachinon.—R. Böttger and T. Petersen.—Notwithstanding the scientific value of this essay, its very great length renders it impossible to quote any details excepting the headings of the sections into which it is divided:—α dinitro-anthrachinon, $C_{14}H_6(NO_2)_2O_2$; α diamido-anthrachinon, $C_{14}H_6(NH_2)_2O_3$; behaviour of this body with nitrous acid; behaviour of α dinitro-anthrachinon with concentrated sulphuric acid; researches on the absorption-spectrum of alizarine.

On Toluylen Alcohol, Isotoluylen Alcohol, and Stilben Alcohol.—H. Limpricht and H. Schwanert.—Toluylen alcohol is a solid crystalline substance, having no constant melting-point, difficultly soluble in hot water, and readily so in ether and boiling alcohol. Toluylen alcohol yields, with glacial acetic acid, an ether—

$$C_{14}H_{12}(C_2H_3O)_2O_2,$$

a solid crystalline body, insoluble in water, but readily soluble in alcohol. Isotoluylen alcohol is also a solid body, fusing at 96°, soluble in alcohol; simplest formula, $C_{14}H_{12}O_2$. Stilben alcohol, $C_{14}H_{14}O_2$, is obtained by heating benzoin along with an alcoholic solution of caustic potassa; the substance alluded to crystallises in large-sized prismatic crystals, is readily soluble in ether and hot alcohol, and fuses at 132°. The authors describe in this lengthy essay a series of combinations of these substances with other compounds, and the reactions which take place when these bodies are treated with various chemicals.

Essential Improvement of the Method of Fractional Distillation.—E. Linnemann.—This essay is illustrated by engravings representing an ingeniously contrived apparatus for fractional distillation, and recording a series of very accurately made experiments with the same.

The Chlorhydrates of Hydroxylamine.—W. Lossen.—Semichlorhydrate of hydroxylamine may be obtained in crystalline state, but, being very deliquescent, it is only so obtained from a very concentrated aqueous solution; this substance fuses at 85°, and consists of $2NH_3O,HCl$. The sesquichlorhydrate, $3NH_3O,2HCl$, is also a deliquescent body, fusing at 95°, somewhat soluble in alcohol, but not at all in ether.

Preparation of Absolute Alcohol.—E. Erlenmeyer.—After briefly referring to the difficulty and loss of time experienced in the preparation of absolute alcohol by the aid of such substances as carbonate of potassa, anhydrous sulphate of copper, dried ferrocyanide of potassium, caustic potassa, caustic baryta, &c., the author states that, after all, caustic lime is the best, and, indeed, as proved by Dr. Mendelejeff (*Zeitschrift für Chemie*, 1865, p. 260), the only, substance which will answer the purpose of rendering alcohol anhydrous. The author has somewhat modified Mendelejeff's method by causing the alcohol (of course very strong, and containing already less than 5 per cent of water) intended to be made absolute to boil along with the caustic lime for about one hour, the apparatus being so arranged that any condensed alcohol flows back into the retort. After the lapse of the time alluded to, the distillation is proceeded with, the result being that the distillate (several litres by bulk) is all obtained in anhydrous state. With an alcohol containing more than 5 per cent of water this same operation has to be repeated several times.

The Question whether the Allyl Alcohol Contains or does not Contain the Methyl Group.—E. Linnemann.

Journal für Gasbeleuchtung und Wasserversorgung, No. 22, 1871.

The original papers contained in this number relate strictly to subjects on gas- and water-works' engineering and management.

Journal de Pharmacie et de Chimie, November, 1871.

This number contains the following original papers and memoirs relating to chemistry:—

Mode of Distribution of Potassa and Soda in Plants.—E. Peligot.—This essay is mainly the same as that published in the *Comptes Rendus* of November 6 last (see CHEMICAL NEWS, vol xxiv., p. 252).

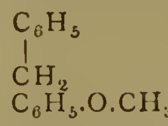
Some Particulars on the Analysis of so-called Roman Camomile Flowers (Anthemis Nobilis).—Dr. Camboulises.—After first referring to the researches of M. Pattone on the common camomile *(Anthemis arvensis)*, published some years ago, the author states that the flowers he experimented with contain, in addition to an essential oil, fat, a bitter principle, glucose, and a very small quantity of a peculiar acid, which seems to be identical with anthemic acid. The ash of the flowers contains sulphate and carbonate of potassa, chloride of potassium, a soluble alkaline phosphate, silica, carbonate of lime, and phosphate of lime and magnesia.

Alkaloids of the Cinchona Trees.—Dr. J. E. Vrij.—The quantitative estimation of the cinchona alkaloids as carried on by the author is based upon:—(1) The very slight solubility of the bitartrate of quinine in water, and the large solubility of the bitartrates of the other alkaloids; (2) the slight solubility of the neutral tartrate of cinchonidine in water, and the somewhat greater solubility of the neutral tartrates of the other alkaloids; (3) the great tendency of iodosulphate of quinine to be formed by the addition of an alcoholic iodine solution to a solution of quinine in alcohol at 50 per cent, containing 1-20th of sulphuric acid, and the slight solubility of this compound in alcohol at 95 per cent; (4) the great solubility of the iodosulphate of the amorphous alkaloid in alcohol at 95 per cent; (5) the existence of at least three alkaloids in all the barks tested by him: (6) all the Indian cinchona barks—of the British as well as of the Netherlands colonies, contain an amorphous alkaloid which is soluble in ether.

Gazzetta Chimica Italiana, December, 1871.

This number contains the following original papers and memoirs:—

Synthesis of a New Phenol.—Dr. E. Paterno.—After first referring to some researches of Drs. A. Jena and T. Zincke, collaterally bearing upon this subject, and published some years ago, the author states that he obtained, by mixing, equivalent quantities of chloride of benzyl and anisol, and, heating this mixture along with zinc-filings, a strong reaction ensues, hydrochloric acid being evolved; the liquid, having been decanted from the zinc, and, submitted to distillation, yields an oily fluid heavier than water, very transparent, which, on being analysed, gave results leading to the formula $C_{14}H_{14}O$; constitutional formula—



$$\begin{array}{l} C_6H_5 \\ | \\ CH_2 \\ C_6H_5.O.CH_3 \end{array}$$

This formula is confirmed by the fact that when the compound alluded to is heated up to 150° along with hydriodic acid in a sealed tube, iodide of methyl is formed.

Action of Bromochloride of Phosphorus on Chloral.—Dr. E. Paterno.—After first referring to his researches on the action of perchloride of phosphorus on chloral (*Giornale di Scienze Naturali ed Economiche*, vol. v., p. 117), the author describes at great length his experiments on the subject alluded to, the chloral being the anhydride. The result of the reaction is the formation of a compound, $C_2HCl_3Br_2$, a perfectly colourless transparent liquid, which strongly refracts light, is gradually decomposed by direct sunlight, and becoming yellow-coloured; its smell is agreeable and slightly camphor-like; it is insoluble in water; boils, but is partly decomposed, at 200°; is not congealed by exposure to the cold produced by a mixture of snow and salt; sp. gr. at 0° = 2·317.

On Two New Chlorobromides of Carbon.—Dr. A. Paterno.—This lengthy essay is divided into the following sections:—Action of bromine upon chloroform; hereby is formed a substance, CCl_3Br, a transparent very mobile liquid, perfectly colourless when first prepared, but becoming decomposed even by exposure to diffuse light, bromine being set free; the odour emitted by this substance is agreeable, and somewhat akin to that of a mixture of chloroform and chloride of carbon; this chlorobromide of carbon boils at 104·3°, and has a sp. gr. at 0° = 2·058. Action of bromine on pentachloride of dimethyl; hereby another chlorobromide of carbon is formed, $C_2Cl_4Br_2$, a crystalline solid.

Bromide of Ethyliden.—Drs. E. Paterno and G. Pisati.—By causing bromochloride of phosphorus, $PhCl_3Br_2$, to act upon pure aldehyde, the authors have obtained a product, which, having been rectified, was found to boil at about 112°, and to be composed of $C_2H_4Br_2$, and is therefore a bromide of ethyliden.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 10, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

On Electrolysis, and on the Conduction of Electricity through Fluids.—G. Quincke.—The continuation and end of this very lengthy memoir.

Composition of the Native Tantalum and Niobium Compounds, and more especially of Tantalite, Columbite, and Pyrochlor.—C. Rammelsberg.—The continuation and end of this very exhaustive mineralogical essay.

Action of Light upon Chlorine and Bromine.—E. Budde.—The leading points of this paper may be summarised as follows:—Light (sunlight) decomposes the molecules of chlorine; light acts also in another manner (the nature of which is not precisely known) in which, becoming converted into heat, it causes expansion; the division of the solar spectrum, according to Melloni, into a heating and non-heating chemically acting portion, is not quite correct, since there exist substances which are more heated by the violet than by the red rays.

Mineralogical Communication.—G. vom Rath.—Tenth portion of this essay, treating on the chemical composition of the lime-soda felspars, a contribution to the doctrine of isomorphism. To be continued.

Evolution of Heat which Accompanies the Drawing-Out of Caoutchouc.—E. Villari.—A mechanico-physical essay.

Influence of the Astronomical Motions on Optical Phenomena.—E. Ketteler.

Sound Emitted by the Cuckoo Considered in its Acoustical Relation.—J. G. Oppel.

Preparation of Collodium Paper.—E. Zettnow.—The detailed account of a series of experiments made by the author on this subject.

Microscopical Composition of Clay-Slates and Roofing-Slates.—F. Zirkel.

Chromatic Polarisation of Hailstones.—J. Müller.—From the author's researches it appears that hailstones are not made up of amorphous but of crystalline ice, which is put together in all directions.

Use of Cylindrical Lenses for Spectrum Observations.—L. Schönn,

Caloric Condition of Sound-Giving Columns of Air.—Dr. H. Schneebeli.

Les Mondes, December 28, 1871.

Fourth Centenary of Copernicus.—Great preparations are being made at Posen (Prussian-Poland) for celebrating on February 19 next the fourth centenary of the celebrated astronomer, who, though born at Thorn, was in reality a Polander, and inscribed as such at the University of Padua (Italy), where he studied.

Reform of the Legislation of the Brevets d'Invention.—Count de Douhet.—The author, a member of the National Assembly of France, gives an excellent review on this subject, pointing out what has to be amended and improved.

Luminous Meteors and Auroræ Boreales Observed in Italy during the Month of November.—Rev. Father Denza, S.J.

Diving-Bell.—G. B. Toselli.—Illustrated with woodcuts. Description of a novel apparatus which has been successfully tried in the Mediterranean.

There is added to this number a separate half-sheet, which bears the title of—

Panorama du Tout Savoir, Arbre des Connaissances Utiles Réduit à ses Branches Mères, par E. Lagout.—The contents of this paper deserve attention on account of the excellent and concise, yet clear, method of exposition.

January 4, 1872.

Important Invention.—E. Dubois.—The author states that he has been for some time engaged with experiments on devising means for so arranging ships' compasses as to obviate the effects of the deviation of the magnetic needle, and thereby preventing fatal accidents to vessels at sea in consequence. The result is an instrument termed a gyroscope-compass, which has been tried and found to answer admirably on board of two French men-of-war.

Oxyhydrogen Light in the Streets of Paris.—Rev. F. Moigno.—From a short notice on this subject, we learn that the light alluded to (similar to that exhibited at the Crystal Palace) has been now introduced in some parts of the Boulevards of Paris; the success is complete in every respect, and does great credit to the inventor, Tessié du Motay.

Observations on Dr. J. von Liebig's Essay on Fermentation.—Dr. Pasteur.—Notwithstanding the intrinsic merits of this memoir, its contents are not suited for useful abstraction.

Autographic Electro-Telegraphic Apparatus.—M. Meyer.—Illustrated by woodcuts.

Electro-Telegraphic Relais Based upon a New Electro-Magnetic Principle.—M. D'Arlincourt.—The description, illustrated by engravings, of an instrument whereby telegraphic messages can be transmitted, without the necessity of being first forwarded to any intermediate station, at once to the place of destination, however distant that may be from the starting-point.

Study on the Molecular Vibrations of Mercury and of Liquids in General.—M. Barthelemy.—The description, illustrated by woodcuts, of a series of acoustic experiments.

Polytechnisches Journal von Dingler, second number for November, 1871.

This number contains the following original memoirs and papers relating to chemistry and collateral sciences:—

Present Condition of Aërial Navigation.—T. Springmann.—This elaborate memoir, illustrated by several engravings, contains a very complete and well-digested account of all that has been done in this direction in various countries.

Hydraulic Properties of Gypsum which has been Ignited to Red Heat.—F. Schott.—From the contents of this lengthy essay we quote the following essential points:—What is usually termed overburnt gypsum reassumes, after a lapse of some days, its property of absorbing water, and hardening after that. When gypsum is heated to a temperature higher than that at which it parts with its water of hydration, it hardens, and somewhat fuses, becoming more dense, and taking up water less readily; this gypsum takes up less water, and thereby becomes a harder mass than is usual with so-called plaster-of-Paris. The following modifications of sulphate of lime exist:—(*a*) Crystallised hydrated (as met with native), with 20·93 per cent of water of hydration. (*b*) Three-fourths dehydrated (as is the usual so-called plaster-of-Paris), containing 4·27 per cent of water of hydration, readily hardening after having been mixed with water. (*c*) Completely dehydrated gypsum, but not heated above 200°, readily hardens when mixed with water. (*d*) Anhydrite (native), takes up water slowly, and only after a length of time, but does not become hydraulic. (*e*) Gypsum heated to red-heat, or to from 400° to 500°, also anhydrite, but becoming hydraulic, that is to say, yielding with water a kind of hydraulic lime.

Softening of Water by Means of Lime.—J. Stingl.—The author records the results of a series of experiments made with water in use at one of the railway stations at Vienna, where, for the purpose of softening the water to be applied for feeding locomotive-engine boilers, the lime process is in use, to which is added a peculiar mode of filtering, so that the tedious process of obtaining the water clear by letting a sediment form is got rid of. There are added to this paper results of analysis of the water before and after softening, of the boiler incrustation due to the softened and unsoftened water, and of the residue left on the filters. If water contains in addition to carbonate of lime much gypsum, it is first treated with lime, and next with carbonate of soda.

Simplified Method of Estimating Carbonic Acid in the Gas used for Saturation (viz., of Lime) in the Sugar Refining Industry.—Dr. T. Stammer.—Illustrated with a woodcut essentially required for the proper understanding of the subject.

On Leucoline Oil, and on the Pure Naphthalin of Commerce.—Dr. M. Ballo.—By treating a quantity of some 30 kilos. of crude naphthalin with dilute sulphuric acid by the assistance of heat the author obtained an oily deliquescent mass, which, having been rectified in various ways, was found to be a mixture of various basic bodies wherein leucolin prevails. This oil yields with iodide of amyl and caustic potassa solution a beautiful violet dye, which is identical with that obtained from cinchonin-chinolin; the so-called naphthalin of commerce owes its peculiar odour to leucoline oil, which can be eliminated by treating the naphthalin with bichromate of potassa and dilute sulphuric acid.

Testing Citric Acid for Tartaric Acid.—Dr. Hager.—First a mixture is made consisting of 4 grms. of fused caustic potassa, 60 c.c. water, 30 c.c. alcohol at 90 per cent; this liquid is poured into a glass basin placed on a piece of black paper so as to form a layer of some 6 m.m. high; next crystals of the citric acid to be tested are placed into this fluid so that the crystals do not touch each other and are some 3 to 5 centimetres apart. After having been left quietly standing for about three hours the crystals of citric acid will be found either entirely, or, at least, nearly, dissolved, there being left only a whitish speck where they had lain, but the crystals of tartaric acid if anywhere present will have been left undissolved and covered as well as surrounded with a whitish crystalline mass.

Composition of the Swedish Safety Matches.—A. Kriwanek.—The mass fixed to the wooden splints consists, in 100 parts of—Glass-powder, 8·77; glue, 7·12; neutral chromate of potassa, 7·36; chlorate of potassa, 46·76; hydrated oxide of iron, 5·39; peroxide of manganese, 13·07; sulphur, 7·41; hygroscopic water, 4·22. Friction mass on the boxes—Glue, 3·65; hydrated oxide of iron, 3·19; peroxide of manganese, 13·06; tersulphide of antimony, 50·34; amorphous phosphorus, 29·91.

NOTES AND QUERIES.

Sprengel Mercurial Pump.—Will any of your readers inform me where I can read a good description of the Sprengel mercurial pump and its application to filtering? Also please give some idea of the quantity of mercury required for its proper working.—M.

Refining of Paraffin.—(Reply to "M. P. S.").—You will find the most recent and best information in "Die Industrie der Mineralöle, des Petroleums, Paraffins, und der Harze," &c., von H. Perutz Wein, bei C. Gerold, 1868; you can inspect this book at the Library of the Commissioners of Patents.

Residue from Olive Oil Presses.—(Reply to "Oleum").—It is not likely that you can obtain this material now, the gathering of the olives for preparing oil having taken place some time since; the only way to obtain the olive cake when in season is to apply to some of the wholesale traders in this oil at the ports of shipment, either in France, Italy, or Spain.

MEETINGS FOR THE WEEK.

Monday, Jan. 15th.—Medical, 8.
—— London Institution, 4. Prof. Odling, F.R.S., on "Elementary Chemistry."
Tuesday, 16th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Zoological, 9.
Wednesday, 17th.—Meteorological, 7.
—— Society of Arts, 8.
Thursday, 18th.—Royal, 8.30.
—— Chemical, 8.
—— Royal Society Club, 6.
—— Royal Instititution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
Friday, 19th.—Royal Institution, 9. Prof. Odling, F.R.S., "On the New Metal Indium."
Saturday, 20th.—Royal Institution, 3. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

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The Friday Evening Meetings will commence on January 19th, at 8 o'clock.

PROFESSOR ODLING will give a Discourse "On the New Metal Indium," at 9 o'clock.

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January, 1872.

London Institution, Finsbury Circus.—Dr. ODLING, F.R.S., F.C.S., Fullerian Professor of Chemistry in the Royal Institution, will commence a COURSE of EIGHT LECTURES on ELEMENTARY CHEMISTRY, on Monday, January 15th, at Four o'clock precisely, to be continued on the seven succeeding Mondays at the same hour. Fee for the Course, Seven Shillings and Sixpence. The Course will be followed by an Examination for Prizes and Certificates, open to all Students under the age of Eighteen.

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THE CHEMICAL NEWS.

VOL. XXV. No. 634.

ON THE

ESTIMATION OF NITROUS ACID IN NITRO-SULPHURIC ACID.

By GEORGE E. DAVIS.

IN vol. xxiv., p. 257 of this journal, I compared the chloride of lime process for the estimation of nitrous acid in nitrous vitriol with a permanganate process, and I there showed that with me there sometimes arose discrepancies between the two methods which are difficult to explain. That it is the permanganate process which is at fault may be seen at a glance, although the chloride of lime method is not free from error. This may be seen by inspecting column 2, p. 258, where five different trials of the same sample by the chloride of lime process only showed a difference of two degrees, whilst five more trials by the permanganate process varied between 55 and 60 c.c., making a difference percentically:—

	Chloride of Lime.	Permanganate.
Highest result.. ..	1·212	1·140
Lowest ,, ...	1·184	1·045
Difference	0·028	0·095

The difference between these two processes it will be seen is only very minute, and, indeed, such as is usually allowed as errors of experiment; but such errors, even so small, are scarcely allowable in this case, for the error would be greater than the amount of nitrous acid sometimes found. For instance, on page 249 Mr. W. Crowder states that in the third works where the acid is denitrated by steam and sulphurous acid, that there remains after leaving the column 0·026 per cent of nitrous acid.

By allowing, as I stated before, the solution, by the permanganate process to stand two minutes, results are obtained which are generally 0·1 per cent under the other method; this I first attributed to faulty solutions, but on testing the chloride of lime solution by Bunsen's method, and the permanganate by pure oxalic acid, I found them accurate.

I have, therefore, in my daily determinations always preferred the chloride of lime, for the estimations agree when many are made upon the same sample, and it has the advantage of being the most rapid of all the methods which I have yet tried, and also the least expensive, urea being too dear when four determinations are made in a day.

In order to eliminate this constant difference of 0·1 per cent the operation was reversed, the nitrous vitriol was added to the $\frac{N}{10}$ permanganate, and at first the error was increased instead of being eliminated, which led to the discovery of the fact that the more time employed in the operation the higher the result. As an instance, 50 c.c. of the decinormal permanganate were placed in a flask with a litre of water, the flask was shaken in one hand whilst the nitrous vitriol was delivered by the other, which was added until decolouration took place; 8·2 c.c. were used, which indicated 1·158 per cent. A litre of water was again placed in a flask with 50 c.c. of the permanganate; 5 c.c. of the vitriol were added at once and well shaken, then a few drops at a time, well shaking after each addition: this time, although the same sample of vitriol was operated upon, 6·7 c.c. were only required, which is equal to 1·418 per cent. The sample was then tested by the chloride of lime method; 64 divisions were taken, which indicates 1·609 per cent of nitrous acid; the first experiment occupying two minutes, and the last ten. This lengthening of the process, which I have found to be necessary, corresponds to that in the first permanganate process described, where the pinkish liquid is directed to stand for two minutes; the oxidation at the end of the process taking place very slowly indeed. By taking every precaution to ensure accurate results, numbers have been obtained which agree very closely with the former permanganate process and also with the chloride of lime method.

The table below gives the results of the estimation of the nitrous acid in five different samples of nitrous vitriol by the three processes: 1st, the chloride of lime; 2nd, the process by which the N_2O_3 in 10 c.c. of the vitriol is estimated by $\frac{N}{10}$ permanganate; this I will call the α permanganate process; 3rdly, the β permanganate process, in which the nitrous vitriol is added to 50 c.c. $\frac{N}{10}$ permanganate until decolouration takes place:—

Chloride of Lime.		α Permanganate.		β Permanganate.	
No. of Pouret Div.	Per cent N_2O_3.	C.c. used.	Per cent N_2O_3.	C.c. used.	Per cent N_2O_3.
87	1·184	60	1·140	8·2	1·158
92	1·119	56	1·064	8·5	1·117
64	1·609	79	1·501	6·7	1·418
46	2·239	112	2·128	4·4	2·159
154	0·669	30	0·570	14·1	0·673

To guard against loss of chlorine as much as possible by the chloride of lime method, I now employ a stoppered bottle of 1750 c.c. capacity: a litre of water is placed in, and then the 10 c.c of the chloride solution containing the 7 grs. of chlorine, the nitrous acid is then poured in, the stopper instantly replaced, and the bottle well agitated; this is repeated until there is no smell of chlorine; a few drops of indigo sulphate are then added, and if the solution keeps its blue colour the operation is ended. Both nitrous acid and chlorine decolourise indigo, therefore if the bottle with its contents are allowed to stand some time before being washed out, the operator will have a good indication whether an excess of nitrous vitriol has been added or not.

Although the chloride of lime method has been spoken of as the best to use for technical purposes, and one which may be so readily applied, yet there are cases in which its use is not to be recommended. There are, when the acid contains only traces of nitrous acid. I say traces, but to be more exact I will say, when there exists only from 0·2 to 0·02 of N_2O_3 in the 100 of acid; 0·171 of nitrous acid per cent would require 600 divisions to be added, therefore requiring six fillings and emptyings of the pouret.

The process to use in this and similar cases is the permanganate process, which in the instance of traces of N_2O_3 is very readily and quickly performed. It has been hinted to me by several chemists since the appearance of my paper on the subject that the lower results of the α permanganate process were caused by the liberation and escape of nitrous acid by dilution with water. I wish now to state that such is not the case, there is no liberation of nitrous acid into the atmosphere of the flask and consequently no escape. The nitrous vitriol is taken up with a 10 c.c. pipette, and the point is inserted to the bottom of the water in the flask; the vitriol is now allowed to run out and form a layer at the bottom of the water; now by giving a slight circular motion the water and vitriol may be made to mix without any loss. As I have before stated in my experiments, iodide of potassium and starch-paper were not affected at all by the air of the flask immediately over the solution.

For some time I found it very difficult to explain why the colour of the permanganate which seemed permanent should go after standing a few seconds, but I think now that this peculiarity may be traced to the behaviour of N_2O_3 with water.

Nitrogen trioxide or nitrous acid is generally admitted to be decomposed by water after the manner of the following equation: $3N_2O_3+H_2O=2HNO_3+2N_2O_2$. Three molecules of nitrous acid require 6 atoms of oxygen to oxidise it to nitric acid; that is one side of the equation. Two molecules of nitric oxide require 6 atoms of oxygen also; this is the other side.

Thus there is no difference in the *amount* of oxygen required for the oxidisation of the nitrous acid contained in vitriol, either before or after dilution with water; but it is very probable that the N_2O_2 cannot assimilate the oxygen of the permanganate so easily as the N_2O_3; consequently the decolouration is retarded.

Mr. W. Crowder has given the results of denitration under varying conditions. I here append a table containing some of the results obtained in denitrating with chamber acid and the hot sulphurous gas; the first relates to the absorbing column, and the acid going to it was tested by the α permanganate process. The acid coming from it was tested by the chloride of lime method:—

	To Absorbing Column.		From Absorbing Column.	
No.	Density.	P.c. of N_2O_3.	Density.	P.c. of N_2O_3.
1	152	0·130	148	1·338
2	152	0·197	148	1·426
3	156	0·166	149	1·717
4	151	0·092	145	2·102
5	155	0·123	148	2·803
6	154	0·088	150	1·936
7	158	0·162	152	2·557
8	156	0·076	152	1·342

	To Denitrator.		From Denitrator.	
No.	Density.	P.c. N_2O_3.	Density.	P.c. N_2O_3.
10	149	1·839	152	0·184
11	153	2·056	153	0·126
12	151	1·788	149	0·097
13	150	2·264	138	0·104
14	150	1·212	133	0·067
15	152	1·875	140	0·086
16	118	0·1266	—	—
17	124	0·1393	—	—
18	121	0·1692	—	—

In the above tables Nos. 1, 2, 3, and 4, were run down from the denitrator at that strength; Nos. 5, 6, 7, and 8, were run down at 138, and boiled down to the strength indicated by the tables.

Nos. 10, 11, and 12 are specimens of denitrations when the acid leaving the denitrator is strong enough to be employed in the absorbing column.

Nos. 13, 14, and 15 are specimens when the acid was leaving the denitrator at a density varying from 133° to 140° T., and 16, 17, and 18 represent the chamber liquor which was being run down the denitrator with the nitro-sulphuric acid.

January 8, 1872.

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

VIII.

From the frequent occurrence of the necessity of identifying blood stains in medico-legal cases it is desirable that a good test should be known; there is one which answers the purpose fairly, but unfortunately does not differentiate human from animal blood. This is the guaiacum test.

The constitutent, hæmatine, upon which the reaction is based, is identical in all blood, even that of the common earthworm; this identity is proved by the spectroscopic appearances.

To apply the above test, place a drop of blood on a white surface of porcelain, and add to it a drop of simple tincture of guaiacum; to this add a drop of solution of peroxide of hydrogen (H_2O_2); a blue colour will be developed. If the stain of blood be dry, moisten with glycerine, apply the tests and press it with a piece of white blotting-paper; this will absorb the colour.

The action depends on the oxidation of the guaiacum in the presence of the hæmatine.

The red corpuscles of the blood are composed principally of hæmatocrystalline — that is, hæmatine, the colouring matter, and crystalline or globulin, an albuminoid body identical with the substance obtained from the crystalline lens of the eye.

Hæmatocrystalline may be obtained from its aqueous solution in crystals by subjecting it to cold. To obtain hæmatocrystalline from corpuscles, separate them from defibrinated serum with salt water and then wash with ether and water; the water dissolves the hæmatocrystalline. These crystals have a very complicated formula, and a molecular weight of about 13280, the highest molecular weight at present known (Thudichum). These results were calculated from Schmidt and Seyler's analyses, the formula given being $C_{600}H_{960}N_{154}FeS_3O_{177}$.

Hæmatocrystalline is an exceedingly stable body, remaining undecomposed in putrid blood of long standing.

Hæmatine, the colouring matter of blood, contains Fe in large quantities, 7 per cent of the ash; it cannot be wholly separated, but the colour is not affected by the removal of that portion which can be removed.

I mentioned in last demonstration that corpuscles are essentially carriers of O; this is proved in a very pretty manner by reducing arterial blood with H_2S, or protoxide of iron in ammonia tartrate, and subjecting to spectrum analysis; the bands of venous blood immediately appear, by exposure O is absorbed from the air, and the arterial bands appear.

Hæmatine may be obtained from hæmatocrystalline or the crude corpuscles by washing with alcohol acidulated with H_2SO_4.

Hydrogen phosphide and hydrogen sulphide reduce hæmatine, and CO, NO_2, and HCN combine readily with it.

Cruentine, an interesting body obtained from blood in the form of sulphate, by treating with H_2SO_4, is remarkable for a property known as fluorescence, and peculiar to a few substances only.

Chloroform saturated with cruentine sulphate, and subjected to a cone of sunlight or the extreme violet acid of the spectrum, gives this fluorescence in a beautiful manner.

Besides the bodies already mentioned, there are a few others, as albumin in the serum, some phosphorised fat, urea, cholesterine, and other matters about to undergo excretion.

NOTE ON THE OXIDATING POWER OF SOLUTIONS OF PERMANGANATE OF POTASH.

By HUGO TAMM.

While Professor Schulze was engaged in his researches on the oxidising power of alkaline solutions of permanganate of potash, I was carrying out similar experiments on neutral soutions of this substance, and I was studying their action on the substances which reduce them.

I studied, at first very roughly, the action of the chameleon on various substances, such as filter-paper, tartaric acid, coal-gas, tallow, turpentine, benzol, alcohol, ammonia, &c. The two most interesting facts which I found then were that alcohol boiled with a neutral solution of permanganate of potash was partially transformed into acetate of potash, and that, in the same conditions, ammonia was converted into *nitrate of potash*.

It is not likely that I shall be able to publish shortly my researches on this subject, but it is a great satisfaction to me to corroborate the importance of Professor Schulze's discovery by the publication of a not less interesting fact, viz., the direct oxidisation of ammonia by purely chemical means, a reaction which, as far as I can recollect, had not been obtained before.

TESTING COCHINEAL.

By J. M. MERRICK, jun., S.B.

I give in the following article the outlines of the method I am in the habit of using for testing samples of cochineal to ascertain their comparative colouring powers. I have not seen it described in print, and while it is a much closer and more accurate method than that which is based upon dyeing strips of mordanted woollen stuffs, it is preferable to the bleaching with chloride of lime method, as the oxidising substance used, viz., potassic permanganate, does not precipitate the colouring matter of the cochineal.

I grind to a fine powder the samples to be tested, weigh out 2 or 2½ grammes, and boil this amount in a capacious narrow-necked flask, with 750 c.c. of water, for one hour. The liquid is immediately filtered through, dry paper filters, and tested when cold. To test it 50 c.c. are measured in a flask of that capacity and poured into another flask of about 200 c.c., and the measuring vessel rinsed with a definite quantity of water, say 10 to 15 c.c.

A weak solution of permanganate is then run in from a burette with a glass cock, the flask being shaken well after the addition of every 10 c.c.

So much permanganate solution is added that the cochineal extract shall be changed from its original colour to a pink of the very faintest shade—almost yellow, in fact, but never reaching a full yellow. This pink shade should be persistent, that is, it should not turn yellow after standing fifteen minutes; and after a little practice it will be found very easy to obtain the tinge, which shows that the colouring matter is almost but not quite destroyed.

When a number of samples are to be compared I arrange an equal number of 200 c.c. flasks and test-tubes on the table, a tube standing in its rack in front of each flask. Then the *same* number of c.c. of the permanganate solution (which should be at least so weak that bulk for bulk of this and the cochineal solution will be required), is run into each flask, taking care to use too little to completely destroy the colouring matter in *all*. The flasks are well shaken and allowed to stand for ten minutes.

Part of the contents of each is then poured into the corresponding test-tube, and a glance at the tubes as they stand side by side will show which is the least affected by the bleaching liquid. This sample having been selected to serve as a standard, the contents of the test-tube are returned to this flask, and more permanganate solution is cautiously added, until a very faint pink tinge, which a fraction of a c.c. will turn to a full yellow, is obtained.

The number of c.c. used having been noted, a fresh trial is made, in which the c.c. required, minus one, are used, the flask agitated, and the last c.c. or part of it, as the whole may not be necessary, added. If the two results agree, the next sample is treated in the same way, and so on until all are tested.

I usually make a final trial by measuring the 50 c.c. of each solution into its flask, running in the permanganate in the ascertained amount into each as quickly as possible, letting the flasks stand ten minutes, and then making a comparison of all in the test-tubes.

If the shades are not exactly alike, a pretty good guess can generally be made of the fractions of c.c. required, which should be added, the contents of the tubes being joined to that in the flasks, and a second or third comparison thus made.

This is a rather long description of what in practice is a very simple and good process, the three principal points to be borne in mind being,—

1st. To use a weak solution of permanganate.

2nd. To have a very faint pink colour as a standard of comparison.

3rd. To let the liquids remain after agitation together 10 to 15 minutes before comparing them.

I may add, that it is very remarkable how little can be told of the value of a sample of cochineal by a mere physical examination, and that the frequent inconsistency between value and price is equally surprising. I have known samples to differ *thirty* per cent in colouring power, and only one or two cents per pound in price.—*American Chemist.*

ON THE MANUFACTURE AND REFINING OF SUGAR.

By C. HAUGHTON GILL.

The subject of sugar divides itself naturally into two branches—the preparation of the raw material, and the refining or rendering it fit for use. Taking these two branches of industry together, I find that the result is, that, in 1866, the total consumption amounted to something like three millions of tons, reckoning only that which came through European hands in some way or other, and of this amount nearly one million tons were manufactured in Europe from beet-root. No doubt some of you have heard that sugar made from beet-root is not so sweet as that ordinarily used in this country, which is made from the sugar-cane. This is quite a mistake. Sugar procured from the cane and from beet-root is exactly the same; and I wish to impress this upon you particularly at the outset, inasmuch as, in describing the operation of refining, I shall make no distinction between them, except in immaterial details. Sugar from either source is known as "cane-sugar."

I must next assign limits as to what I have to tell you. You must understand that I have nothing new to say upon this subject, but simply to explain to you what is known to every chemist who has studied the subject of the production and refining of sugar. I shall confine myself simply to telling you what is done in certain cases, and why it is done.

But, in order to explain the reason why such operations in the manufacture and refining of sugar are carried out in the form in which they are, I must first bring to your knowledge certain facts in chemistry and physics, and as I cannot advantageously unite these explanations with the descriptions of the processes themselves, I propose to occupy this first lecture on bringing before you some of these physical and chemical facts which I shall have afterwards to apply; and though this may appear a somewhat round-about way of attaining my object, I think it will really conduce to brevity and clearness.

First of all, I must state that the sugar which we obtain from the sugar-cane or beet-root exists already formed in those plants. It is not created by the process of manufacture, but exists in the plant, dissolved in water, in the shape of juice. But together with the sugar we find dissolved a variety of other bodies. I have in this bottle some of the pure juice of the sugar-beet which has been pressed out, and from the colour, which is nearly black, you will readily perceive that it is not a solution of pure sugar. It contains, among other bodies, a substance which approaches very nearly to the white of an egg, or albumen, and also some bodies like gums, the presence of which I can show you by adding to the liquid a solution of tannin, the astringent principle of oak-bark. By adding this, you will see in a few moments that these albuminous matters settle down in flocks, having formed insoluble compounds with the tannin; or I can show their presence more

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* The Cantor Lectures, delivered before the Society of Arts.

readily by using another reagent called "basic acetate of lead," which precipitates most of these albuminous and gummy substances as insoluble lead compounds. This basic acetate of lead has now produced a thick greenish precipitate in the beet-juice, and on filtering the mass you see that a clear, colourless liquid comes through, which you must understand contains the sugar of the original juice. Cane-juice contains the same, or similar impurities as beet-juice, though in much smaller proportions. The object of the sugar-makers is to remove, at the first operation, as many of these impurities as possible, so as to make his juice approximate as nearly as may be to a solution of pure sugar; but preliminary to the treatment of the juice comes the question of winning it, or getting it out of the plant. The most obvious way of doing that is to crush or rasp up the plant, thereby destroying the little cells in which this solution of sugar and other bodies is contained, and this is the method which is most commonly employed. I will go more into detail with regard to the extraction of the juice when I come to speak of the manufacture of beet-root sugar, which is that branch of the subject upon which I shall more specially enlarge; but I may here mention that there is another way of obtaining the juice, which, at any rate in principle, is preferable, but to explain to you what this is, I must first give an illustration of an important physical fact.

I have in this glass a solution of a gummy body, called dextrin, which is perfectly soluble in water, and a solution of which will readily filter through porous paper. I will mix with this a solution of bichromate of potash, which is a coloured salt, and, having mixed the two together, I will now fill a small sac, which is part of the gut of the rabbit or some small animal, with some of this yellow solution. The sac is what is called watertight, and I will now suspend it in a vessel filled with pure water. In process of time we shall see the solution the of this orange-coloured crystalline salt, the bichromate of potash, find its way out through the walls of the little watertight sac, whilst the gummy body itself will not pass through the membrane. Whilst that is proceeding, I will start a similar experiment on a somewhat larger scale. Over the mouth of this glass vessel I have a piece of parchment paper, which is quite watertight in the ordinary sense, but still it will allow this curious passage of some soluble bodies to take place through it, although it prevents the passage of others. I will put some of this mixture of dextrin and bichromate of potash into the vessel, and then placing it in a dish of water, we have the two separated simply by that piece of parchment paper, and we shall see that the bichromate of potash will pass through, whilst the dextrin will not. To show you how we can demonstate the truth of this, I must now show you the reaction of the dextrin and of the bichromate of potash. First, I will put a little of the dextrin into water, and add to it a solution of iodine. You perceive that the liquid immediately turns a dark purple colour. By this means, therefore, I can detect the presence of dextrin if it passes through into the water. The bichromate of potash has a very remarkable power of colouring water, and accordingly, even a small quantity of it would be manifested by the liquid turning yellow; but as that is not very visible in this light, I will add to it a solution of acetate of lead, which will form in the liquor a precipitate, the chromate of lead rendering it opaque and yellow. This difference between the two bodies with regard to their passing through moist watertight membranes, is one which is observed between two great series. On the one side we have those bodies which, when dissolved in water, will pass through most membranes, animal or vegetable, when there is water on each side; and we have again other bodies which, like the dextrin, do not possess that power. Those which can pass through are, for the most part, capable of assuming a crystalline condition, and the whole class, therefore, has been designated crystalloid. The others more or less resemble glue in character, and are called colloids. The constituents of cane and beet-juice are partly colloid and partly crystalloid. The solution of them is contained in little cells, which you may compare to the cells of an orange, the walls of which are capable of acting in the same way as this piece of membrane or this parchment paper, causing the separation of the two constituents of the cells, when slices of the plant are immersed in water, the crystalloid constituent passing outwards by this proceess of diffusion, as it is called, and the colloids remaining behind. If, then, we cut up a sugar-cane or beet-root into slices of a convenient size, and immerse them in water, the sugar, which is a crystalloid, and the saline particles of the juice, pass out into the water beyond, while the gummy bodies, to a great extent, remain behind; whereas when we rasp up the plant and squeeze out the juice, we get in it the whole constituents, colloid and crystalloid together. Theoretically, therefore, the diffusion process is preferable to the other. It is attended with some practical difficulties, which, however, have been got over very successfully in India, with regard to cane-juice, and which I have seen worked successfully with regard to the beet-root, though people are not quite agreed about it.

I will now come to the subject of the solution of bodies. Everyone knows, more or less, what is meant by solution, but there are some limitations to the process which are not always understood. If we take a body which is soluble in water, you know it disappears like sugar or salt when stirred up with water. Here is some of the yellow salt which I used just now, and dissolving some in water, you see that the liquid is immediately coloured, and it will go on increasing in colour up to a certain point, but the water will not dissolve more than a certain amount at this temperature. In this bottle there is some of the same salt which had been shaken up in the bottle for some days; the liquid is saturated with salt at this temperature, but though saturated at this temperature, it would not be so at another. For instance, if I put some of this saturated solution of bichromate of potash into a test-tube, and add some more of the solid salt and warm it, we shall find that when the liquid is heated, the power of solution of the water increases, and the solid salt disappears. I may, possibly, have added too much, because hot water has limited powers of solution as well as cold, and if we continued adding the salt to the hot liquid from time to time, we should at length arrive at a point when no more could be taken up, and then the liquid would be saturated at a high temperature. But if, instead of heating this up to the boiling-point, I had stopped short of that, and only saturated it at a temperature half-way between the boiling-point and the ordinary temperature of the room, I should have dissolved more of the salt than at the lower temperature, but less than at the higher. You must understand, therefore, that it is not because a liquid is what is called warm that it will dissolve as much of a given body as it will when it is boiling hot. As a rule, that is not the case, especially in the case of sugar. The large quantity of salt which I added here is now entirely dissolved, but on cooling the liquid again you will see, of course, that that portion of the salt which has become dissolved in virtue of the heat will again be deposited, leaving above it a cold saturated solution. It is important to recollect that this is the case, because on this fact depends the final extraction of sugar from its solutions. When the particles of salt, separated in this way from the hot saturated solution have time to arrange themselves in any way which the forces acting upon them may direct, they generally do so in very definite forms, and produce what are called crystals. On the table are two or three examples of crystals which have been formed in this way, by the slow cooling or evaporation of a liquid containing them in solution; the crystals are regular and of large size. But when the crystallisation produced is rapid—when it deposits more quickly—then we find that the deposit takes the form of small irregular crystals or grains. There is another way of obtaining a saturated solution of a soluble body besides this one of dissolving it in a hot liquid, and then cooling it, which is this. If you take a weak solution of a body and take the water out of it, you will obviously arrive at some point at which the body itself will remain relatively in excess. For instance, if I take a solution of common salt, and put it into a basin, and boil away the water, you will find that the salt will gradually crystallise out. Thus we arrive at the same result. We will now examine the result of our experiment on diffusion. I do not know whether it is very visible in the room, but to me it is perfectly clear that the water in the little jar in which the sac was placed is coloured yellow, especially at the bottom; and on examining the dish of water in which the vessel with the parchment paper was placed, I think we shall find the same result. I will divide the water which was outside the dialyser, as it is called, into parts. To one I will add a solution of iodine, and although I have added a larger quantity than I did before, you see there is no perceptible increase of colour. If, however, I add some acetate of lead, which I will do to the other portion, the precipitation shows at once that a considerable portion of "bichromate" has passed outwards. This is merely to show you, by a rough method, what takes place when the juices of plants are subjected to diffusion. Now, taking the liquid within the dialyser, we find that the iodine solution at once acts as vigorously as before upon the dextrine.

I have treated this subject very shortly, but I hope you understand distinctly the point which I wish to impress upon you about the solubility of bodies in cold and hot liquids, but there is a limit to each case, and that between a cold liquid and the hottest which you can make, for every temperature there will also be a special limit to the power of solution. I am speaking in general language, because every chemist present knows that there are exceptions to this rule, and some few bodies are more soluble in cold liquids than in hot; but still the great majority of bodies behave in the same way as sugar, and sugar is far more soluble in hot water than in cold; and for every temperature between the boiling and freezing points of water there is a specified limit of solubility. I have shown you that when a hot saturated solution is cooled, it deposits the salt which was dissolved in it by virtue of the high temperature, but when hot saturated liquids are cooled slowly and carefully, they pass through the limit of saturation in a most curious manner. I have here a flask filled with a perfectly transparent and very strong solution of a salt called sulphate of soda. It is quite cold, having been heated at about 12 o'clock, and it has been standing for some hours in cold water. Still there are no crystals formed, although there is a great deal more salt dissolved in the water than could have been dissolved if I had merely shaken it up with the salt—that is, at present the liquid is what is called supersaturated, and this state of supersaturation will continue until the liquid becomes disturbed in a peculiar way. Some liquids require to be disturbed in one way, and some in another, before this state of supersaturation is destroyed. It may suffice in this case to simply admit the air by withdrawing the cork. As I do so, probably a small particle of dust falls in, and you see, extending from the upper part downwards, an extremely rapidly crystallisation. So it will continue until the whole mass appears solid, the flask being in reality filled with large numbers of very minute crystals. At the same time, the temperature is somewhat risen, but we need not go into that. But what I wish you to understand from this experiment is that a liquid of a given temperature may at a given moment hold in solution more of a solid than it ought to, and in that case we call it supersaturated. We know nothing, I believe, at present why it is so, at least in many cases; in this particular case I believe it has been fairly explained. I will illustrate the same point in another case, in order to show you that, in some cases, we must disturb the liquid in a particular way if we wish to obtain this sudden crystallisation. Here I have a solution of another salt, which has been dissolved for some days. It is one which will admit of considerable rough treatment in the way of shaking without crystallisation; but if I open the jar and drop in a very small crystal of the same salt which is here dissolved, in a few minutes the whole liquid will become solid from the formation of crystals of dissolved material. This shows you that it is more difficult to disturb the equillibrium of sime liquids than others, and that you must seek special means for disturbing them in the right manner. If you dissolve in a liquid, sugar or any other body which is somewhat impure, which contains an admixture of foreign bodies, and then obtain crystallisation either by cooling a strong hot solution, or by evaporating off some of the water, you will attain a very considerable purification of that substance. In the process of crystallisation, the particles of the body come together and form a solid, leaving in solution those bodies which are present in quantities too small to crystallise out of the quantity of water still present and those which cannot crystallise at all. The crystals, when freed from their mother-liquid, must necessarily be considerably purer than the original material. This is an important point, because the purification of the crude sugar of commerce and rendering it into that beautiful white state in which we see it depends in a great measure on the power of crystallisation to separate impurities.

Having thus treated, as far as I am able at the present time, the subject of crystallisation, both in the ordinary case and from supersaturated solutions, I must proceed to describe what we understand by the term boiling, and to show under what conditions liquids can be boiled, and how the temperature at which they boil will vary under certain circumstances. You have all seen water boiling, and you know that when water is contained in a vessel, and heat applied to the bottom, large bubbles, not of air but of steam, are formed there, and rise through the liquor, creating quite a commotion, which we term boiling. Let us go back from that for a moment to the evaporation of a drop of water. If you spill a drop of water, you know that in a short time it dries up and disappears—it passes away into the air. This, of course, arises from the particles of the water gradually rising from the surface of the liquid into the air, and in so rising they had to overcome the pressure of the air on the surface of the liquid. You know that air presses with a force of about 15 lbs. per square inch, and that force tends to keep the particles down—to press them back into the water again. If that is the case, we should naturally suppose that if we could remove the atmosphere, the particles would rise more freely, and that is so. If we put a drop of water under the vacuum of the air-pump, it dries up very quickly indeed, there being nothing to keep it back. But what do we do when we apply heat to a liquid in a vessel? You know that you can dry wet, moist writing, or any other liquid, before the fire more quickly than if you simply expose it to the air at ordinary temperatures. This must be because the heat causes the particles of water to rise more quickly and readily, that is, it gives them a greater force to overcome the pressure of the atmosphere. If you put water into a tube and heat the bottom, you give the particles a tendency to separate and fly apart from one another, and at a certain temperature they succeed in flying apart and form what is really a true gas, water, vapour, or steam, which, being lighter than the surrounding water, rises through it and disappears. Is it not plain, then, that if the pressure on the water is rendered less, we shall not have to heat the water so much to give this vapour an elastic force or tension sufficient to overcome the pressure? The lower the pressure to which the water is subjected, the less is the temperature to which we shall require to raise it in order to make its vapour overcome the remaining atmospheric pressure on it. I can illustrate that by experiment. I have here a flask which is connected by a flexible tube with the receiver of an air-pump, so that when the air-pump is set working, it will draw more or less of the air out of the flask, and, accordingly, I shall be able to put warm—not boiling—water into the flask, and submit it to a less pressure than that of the atmosphere. Before doing so, I must first put a few little bits of some metal into the flask, or else the water will boil very irregularly. Water boils in metal regularly, but in glass very irregularly and with great commotion; but by putting in a few fragments of metal you overcome this difficulty. This water which I put in the flask is hot, but still it is much below the boiling-point. Upon working the air-pump a few moments, as the atmosphere is withdrawn, the force which the vapour will have to overcome will become less and less, and presently the pressure will fall so low that the vapour of this merely warm water will be able to come away out of the liquid as freely as it could if I had been applying a powerful heat to the bottom of the vessel, and thereby increasing the tension of the vapour. This boiling of water under these conditions is a thing which everybody is acquainted with, but still it is one which I am bound to bring before you at this time, because it is the principle of the vacuum pan which I shall have to speak of hereafter.

From this point I may pass on to a few reactions and decompositions of sugar itself, which, I must mention, although they are somewhat tedious, admit of very few experimental illustrations which are visible at any distance. The precautions which are, or rather ought to be, observed in sugar-making depend on a knowledge of these decompositions, to which sugar is subjected when these precautions are not attended to. Sugar itself, in the purest form in which we have it, is a white crystalline body, sometimes occurring in very large crystals, composed of three elements only—carbon, hydrogen, and oxygen. The proportion in which they are united I need not trouble you with, but I may say that if other considerations allowed of it, we might regard it simply as a compound of carbon and water, the oxygen and hydrogen being in the same proportion as that in which they combine to form that liquid. When sugar is submitted to a variety of chemical actions, the first change which it submits to is a change of this kind, that the elements of water are either abstracted from it or are added to it. The changes which occur where water is removed from it may be illustrated thus:—When sugar is heated, it first melts, then, if the heating is continued slowly and regularly, it parts with one molecule of water, then with another, then another, and so on, becoming successively converted into a variety of bodies, the names of which I need not trouble you with, but which, I may remark, are all uncrystallisable, and not sweet, and passing at one stage into a mixture of bodies having very dark colour, which I dare say is known to most of you under the name of caramel. This conversion into a dark-coloured body, by the action of the heat, occurs, not only when sugar is heated by itself in a dry state, but also when it is heated for a long time in concentrated aqueous solution to a somewhat high temperature. If you take a very strong aqueous solution of sugar, and heat it in contact with a hot surface, a portion of it gets converted into this brown material, and colours the whole mass. One of the main improvements in the manufacture of sugar has consisted in evaporating the solution of that body at so low a temperature that this change of sugar into caramel can only take place to a very small extent. There is another change which I must refer to, of an opposite character, which consists in adding water to the molecules of sugar, not merely in the same way in which we add water when we dissolve it, but in a chemical sense, really adding water to its constituents. It is thereby converted into a mixture of two other bodies, very different in character, but having exactly the same composition. The one is known by the name of grape sugar, or dextrose, and the other under the name of fruit sugar, or levulose, specimens of which are on the table. These are the two substances which are produced by the addition of 1 molecule of water to a molecule of sugar; a change which can be effected only too easily in a variety of ways.

When a solution of sugar is heated, or only allowed to stand in an acid state, the change takes place; even very minute proportions of one of the mineral acids, such as sulphuric or hydrochloric acids, act with extreme rapidity, converting the valuable, easily crystallised cane sugar into a mixture of these two other sugars, which are uncrystallisable and comparatively worthless.

I have prepared such a mixture here by the action of dilute acid on a weak solution of cane sugar; and then by removing the acid employed, and by concentration of the resultant liquid I have obtained a body which is something like set honey. This change from cane sugar into that mixture of grape and fruit sugar is one which I cannot very readily illustrate, but I will endeavour, at any rate, to render evident that some change takes place. I will take here a solution of cane sugar, which I will divide into two parts. To the one I will add an alkaline solution of a copper salt, that is sulphate of copper dissolved in caustic soda by the aid of Rochelle salt, and which has, as you see, an intense blue colour. I add it to this solution of cane sugar, when you perceive the liquid remains blue, and on boiling it, unless the sugar was impure you will see no perceptible effect produced. I have boiled it, and the liquid is still of as bright a colour as before. Now, to the other portion, first diluting it, I will add one drop of hydrochloric acid, and heat it momentarily to the boiling-point, or hardly that; you will now see that a marked change has taken place, for, on adding some of the sugar solution so treated to another portion of the boiling blue copper solution, a bright-red colour of suboxide of copper is formed at once, and the liquid loses its blue tint. The action of a very small quantity of acid for a very short time has so utterly altered the nature of the sugar, that whereas while it remained in its original state it was incapable of action on this alkaline solution of copper, now, when it has once been submitted to that action, it exerts a startling influence; it has, in fact, taken oxygen away from the copper, so that whereas you may conceive that this blue solution contains protoxide of copper, a compound of copper, with a certain quantity of oxygen; in this red precipitate which is formed here we have a compound of the same quantity of copper with half as much oxygen, that is, half the oxygen of the copper is taken away by this altered sugar. Another way of illustrating this is by boiling a portion of unaltered sugar in solution, somewhat diluted with water, with a strong solution of caustic soda. We shall find that it undergoes no alteration if it is perfectly pure. You may find it turn a very little yellowish on account of an accidental impurity, but if it is quite pure no visible change whatever will take place. This I wish you to remark particularly, because one of the principal processes in the preparation of sugar from the sugar beet consists in heating the solution with a quantity of lime, which is, in its action, perfectly analogous to soda, being a very strong alkali. It exerts no action on cane sugar, but a very powerful action indeed on the altered sugar, or, as it is sometimes called, invert sugar. I will now repeat the experiment in the same form, only replacing the unaltered sugar by some which has been momentarily heated with a drop of acid. Both the new sugars are totally destroyed as sugar, and the whole liquid turns dark brown, almost black; in fact, the sugars are literally burnt up by the alkalies, although the true cane sugar submits to no alteration.

I must now show you another change which sugar undergoes, or rather, it is the same change as that which takes place when it is acted upon by acids, but produced by different reagents. You recollect that a solution of pure sugar, when boiled with an alkaline solution of copper, which has a brilliant blue colour, does not undergo any change. I will now get the solution of copper boiled, and add to it presently a solution of sugar which has undergone another alteration. I have here a solution of sugar which gives no reaction with this blue liquid; it is very gently warmed, about ordinary summer temperature, and I will add to it a small quantity of yeast, stirred up in water, and allow it to stand a minute or two. You know what yeast is—a body which rapidly produces fermentation in a decoction of malt or any sugary liquid. It will not, in this case, have time to induce fermentation, but it will have time, even in a few minutes, to produce the initial change of fermentation; the conversion of this crystallisable cane sugar into the uncrystallisable mixture of dextrose and levulose, the so-called inverted sugar. This copper solution is now boiling, and I must first show you that the yeast itself is not capable of producing precipitation. Being a cloudy body it will render the liquid rather turbid, but it does not precipitate the red oxide of copper, which, as I showed you just now, the altered sugar does in a ready manner. I have here a portion of the same blue liquid boiled in another flask, and now, after the sugar has been only a minute or two in contact with the yeast, on pouring some of it into the copper solution, you perceive the whole of the blue colour has been destroyed, and the liquid has turned red, owing to the precipitation of the suboxide of copper. The importance of these experiments is this, that it illustrates how excessively pernicious to a sugar-maker it must be to allow even incipient fermentation to occur. If the least trace of fermentation occurs, it inevitably causes the conversion of a very large proportion of valuable crystallisable sugar into the almost worthless uncrystallisable variety.

(To be continued).

PROCEEDINGS OF SOCIETIES.

ROYAL IRISH ACADEMY.

Monday, January 8th, 1872.

Prof. Hennessy, F.R.S., in the Chair.

Mr. C. R. Tichborne, F.C.S., read a paper "*On the Action of Heat upon Solutions of Hydrated Salts.*"

The author used for the examination of the dissociation of water of hydration, such salts as presented a change of colour when passing from the hydrated to the anhydrous state. He had experimented upon those of cobalt, copper, and nickel. Thus, to take the familiar instance of cobalt, the anhydrous salts of which are blue, whilst the hydrated are pink, no amount of boiling will convert a pink solution of cobalt into a blue one, except it is extremely concentrated, but in every case such salts were all changed into the anhydrous condition on boiling under pressure. When the "thermanalytic" point, as the author called t, was reached, the pink cobalt salts were converted into the blue ones, copper into yellowish-brown, and, in the case of chloride, nearly a black solution. Some caution is required in the performance of these experiments owing to the danger of an explosion. An important observation made in connection with these experiments was the fact that dilution acted differently in the cases of chromatic change produced by dehydration and those producing basic results. It is exactly the reverse. The author had pointed out in a previous report that chromatic changes resulting from the formation of basic salts by dissociation (*i.e.*, chromic or ferric salts) is influenced by dilution lowering the thermanalytic point, or the increase in volume of water will assist the dissociation. But in the second class the increase in the volume of water ruins the thermanalytic point and retards the dissociation.

Prof. Sullivan complimented the author upon the importance of this investigation, and this line of research generally.

Prof. Hennessy, F.R.S., &c., then read "*Some Notes of Observations of Phenomena in Optical Meteorology.*" These were descriptions of actual observations, particularly of one where a double rainbow was accompanied by what appeared to be vertical bands of light at a right angle to the horizon.

ROYAL GEOLOGICAL SOCIETY OF IRELAND.

There was a general meeting of this Society on Wednesday, the 10th of January, in the Museum Building, Trinity College.

The only geological papers were two by Mr. E. Hull, F.R.S., "*On the Marble of Carrara,*" and "*On a Remarkable Fault in the New Red Sandstone of Rainhill,*" Lancashire. These were not suitable for abstracts.

NOTICES OF BOOKS.

The Antiseptic System: A Treatise on Carbolic Acid and its Compounds; with Enquiries into the Germ Theories of Fermentation, Putrefaction, and Infection; the Theory and Practice of Disinfection, &c. By Arthur Ernest Sansom, M.D. Lond., M.R.C.P., &c. London: Henry Gillman. 1871.

Starting with the end in view of detailing the several applications of carbolic acid, Dr. Sansom, like an observant traveller, does not immediately confine himself to the road he traverses, but carefully studies the theories and facts he meets with in his journey. His methodical study of theory whilst observing facts we cannot better illustrate than by extracts from the work itself. The practical nature of the work may be judged from the following:—

"*Disinfectant Powders.*—Since 1858 crude carbolic acid mingled with various substances, in the form of powder, has been used for disinfecting purposes.

"(1). The disinfectant powder of MM. Corne and Démeaux (1858 and 1859) consisted of plaster-of-Paris and coal-tar.

"(2). That of M. Bouchardat contained 1 part of carbolic acid in 1000 of plaster-of-Paris.

"(3). That of Parisel contained 1 part of carbolic acid to 100 of coarse meal, and 4 of lard or fat.

"(4). McDougall's powder contains about 33 per cent of carbolate of lime, 59 per cent of sulphite of magnesia, the rest being water.

"(5). Calvert's powder contains from 20 to 30 per cent of carbolic acid mixed with the powdered refuse from alum works.

"When one of these powders (the most efficient being probably the last two) are dusted over a putrescible mass, they prevent putrefaction by poisoning the germs in the air before they reach the mass. They thus filter the air of the elements which dispose to putrefaction. According to Dr. Parkes, half an ounce of either Calvert's or McDougall's powder will preserve four ounces of sewage from 18 to 21 days. . . . . Besides the influence of carbolic acid in these powders, I think their efficacy is probably due to another cause—their power of absorbing water from a moist, putrescible material."

Of the nature of the phenomena of putrefaction and fermentation Dr. Sansom says:—

"I have endeavoured, though I am well aware that the detail is imperfect, to present a faithful picture of the conditions of the questions of the origin of life and the nature of the phenomena of putrefaction and fermentation. It has been the fashion among many medical philosophers to regard the germ theory as a hasty generalisation from imperfect data. I believe I have adduced sufficient evidence to show that its supporters cannot be accused of impatience, that for earnestness of thought and zeal in experimentation they are not inferior to those who differ from them in interpretation.

"In these questions that latitude of opinion which the cultivators of science should never deprecate ought to be especially conceded by those who conscientiously take up the contest. Opinions concerning the force-attributes of matter will be various, according to the bias of the minds of men, and views that are distasteful may be repudiated with insufficient cause. But, given all this latitude, I consider that the germ theory, whilst nothing has been conclusively established against it, is so strongly supported by the convergence of different kinds of observation and different modes of thought, that a dispassionate observer cannot fail to receive it as that highest expression of probability that in biology constitutes a law.

"By germ theory I mean the doctrine that the decomposition of organic material, in the processes known as putrefaction and fermentation, is due to germs, and that these germs are minute particles of living matter derived from a pre-existing living parent.

"Concerning minor points and details there is much room for doubt, and much encouragement for future investigation. I myself incline to hold that the active agents in inducing the changes are vegetable, not animal structures.

"The motile bacteria and vibriones which are observed in the early stages of organic decomposition, inasmuch as they are so universally present that they cannot be considered special to any process, as they can be traced to no form of future development, but may be observed to live their term of life, to die, and to undergo putrefaction, like other organic materials; and as they may be observed in cases wherein all putrefaction is arrested—I consider to be non-essential to the processes of decomposition. On the other hand, I see that fungoid elements play an essential part in the processes; when they are present the phenomena are manifest, when they are absent the converse; agents which quench their vitality arrest the objective signs.

"Fermentations can, according to my view, be distinctly divided into two classes:—1. Fermentations in which there is no reproduction of the ferment. 2. Fermentations in which there is reproduction of the ferment.

"In the first class there is a mere re-arrangement of the molecules, usually without any violent change in the physical constitution of the substances acted upon. It comprises the changes induced by pepsine upon albumen, &c. It corresponds to the class "Fermentations à elements non figurés" of Gautier. The changes are produced by diastase upon starch, by emulsine upon amygdaline, by a soluble or quasi-soluble organic compound, and are not of necessity attended with the appearance of any organism whatever. The circumstance which abruptly divides them from the second class is this: that the ferment inducing them does not become multiplied and reproduced in the process, but tends rather to exhaust itself.

"A fragment of diastase will change a considerable quantity of starch into glucose, but when the change is completed a fragment of the resulting compound will not produce, upon succeeding portions of starch, a like change.

"In the case of alcoholic fermentation, on the other hand, the original power of inducing the fermentation is transmitted to the yeast through successive generations.

"The first class, then, includes fermentations not reproductive; and as the ordinary notions concerning fermentations associate with the process the idea of a reproduction of the ferment as an essential element, I think we should exclude these transformations from the category of true fermentations.

"True fermentation, in my opinion, is a decomposition of an organic material which has a certain uniformity of composition initiated by the vital acts of fungoid organism. Whether these organisms effect the whole decomposition by their acts of life '*purs et simples*,' or whether their activity once manifested, their influence in decomposition is multiplied by a quasi-catalysis, is, to my mind, a secondary question, as yet undecided.

"Putrefaction I consider to be a process analogous to fermentation occurring in a material of more complex constitution than obtains in the latter, or in a material of mixed composition.

"The initial changes are induced by fungoid organisms, which vary according to the material—as it comprises substances capable of the various kinds of fermentation. The material in putrefaction, however, affording a more fitting pabulum for forms of animal life, the complications due to the appearance, vital acts, and mutual decompositions of animalculæ, are superadded to make the process still more complex. The fœtor is chiefly due to the evolved sulphur compounds."

Having shown the power of carbolic acid to prevent fermentation and putrefaction, the author proceeds to ascertain its position amongst other agents which have like powers, and from the data that its chemical constitution is similar to the hydrocarbonaceous matter, which forms so much of the bulk of a fermentescible mass, and that its action is in no way explained by its chemical properties, Dr. Sansom draws the important conclusion, that the chemical constitution and the chemical properties of a body are in no direct relation whatever with the power of that body to arrest fermentive or putrefactive change.

MISCELLANEOUS.

Quality of the Metropolitan Gas.—Dr. Letheby, the chief Gas Examiner appointed by the Board of Trade, has recently submitted his Quarterly Report of the illuminating power and chemical quality of the gas supplied to London by certain of the gas companies; from which it appears that the average illuminating power of the common gas has ranged from 15·58 standard sperm candles in the case of the Imperial Gas at Camden Street testing place to 17·80 candles in that of the Chartered Company, at Friendly Place, Mile End; the average illuminating power of the Cannel gas of the last named company having been 24·93 candles. The amount of sulphur in the gas has ranged from an average of 21·03 grs. per 100 cubic feet of the Chartered Gas at Friendly Place to 40·3 grs. in the same company's gas at Gray's Inn Road testing place. In the corresponding quarter of last year the range was from 19·78 grs. per 100 cubic feet to 33·17 grs.; and in the case of the Cannel gas the average quantity was 28·54 grs. in the quarter which has just expired, while in the corresponding quarter of last year it was only 12·27 grs. at Cannon Street and 24·39 grs. at Arundel Street. The amount of ammonia in the gas has averaged from 0·09 of a grn. per 100 cubic feet to 1·22 grs.—the quantity prescribed by the referees being 2·5 grs.

The Effect of a Grain of Strychnine.—A man in Harrisburg recently attempted to commit suicide by taking a grain of strychnine. The skill of his physician having saved his life, he narrates his experience for the benefit of science. He says: "In the course of five minutes I began to feel slight cramps in the calves of my legs. The cramps increased in intensity and extended to the feet and thighs, causing the most intense pain. I attempted to rise from the chair, but fell to the floor with convulsions in the lower extremities. Unsuccessful attempts were made to bathe my feet in hot water, each effort to raise me bringing on violent paroxysms, in the last one of which I thought my jaws had become unhinged. I was now perfectly paralysed from the hips down, and suffering the most excruciating pains, which began to extend upwards; the muscles of the shoulders and neck were soon considerably convulsed, the forearms still being free from pain. I now prepared for the final struggle, which I knew must be near at hand, as I had become rigid from the neck down, save the forearms. The convulsions of the muscles were becoming fearful, and the torture awful to endure. My hands were drawn in to my sides, with the fingers drawn apart, and slightly bowed, and the jaws became rigid. I felt myself raised as if by some mighty power, and fixed immovably, with only my feet and head touching anything. I became unconscious of everything except my own agony, which was now beyond all description. I could feel my heart fluttering, and my brain beating and throbbing with an irregular motion, as though at every beat it would burst from its confinement. Every joint was locked, and every drop of blood seemed stagnated. I remember thinking it could not long be thus, when I must have lost consciousness. I remember nothing more until I felt a sensation of relief, as though the garments of death which had been drawn over me were being drawn back. Those terrible cramps seemed to be descending towards my lower limbs. A feeling of relief stole over me, and I began to be again conscious. From that time I resumed consciousness, when I was entirely free from cramps, with the exception of a little in the feet. I had but one attack of cramps afterwards, which was immediately relieved by a dose administered by my wife—the doctor having left for a short time—and when he returned, I felt that the poison was completely neutralised."—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, December 11, 1871.

This number contains the following original papers relating to chemistry and collateral sciences:—

Third Memoir on the Discolouration of Flowers by Electricity; Cause of the Phenomenon.—Dr. Becquerel.

Intervention of Atmospheric Nitrogen in the Process of Vegetation.—P. P. Dehérain.—This lengthy essay contains the record of a series of experiments made by the author to prove that, by the assistance of carbonaceous matter in state of decomposition and present in the soil, nitrogen is absorbed from the atmosphere and made available for the plants.

Diffusion of Mercurial Vapours.—M. Merget.—After referring to the researches made by Faraday nearly half a century ago on this subject, the author of this exhaustive essay describes at great length a series of researches made by him on this subject, use being made of paper impregnated with the mixed chlorides of platinum and palladium as a delicate test for detecting the vapours of mercury. The volatilisation of this metal is continuous, and does not even cease when the mercury is solidified by cold; the vapours of this metal are possessed of a considerable diffusive force, and it would appear that this force is equal to that which is deduced *à priori* from the dynamical theory of gases. This important memoir contains, moreover, an account of a large number of scientifically and industrially noteworthy applications of the author's researches.

Composition of Native Phosphate of Lime Recently Quarried in the Départements de Tarn et Garonne and Du Lot.—A. Bobierre.—This paper records the results of a series of analyses of the materials just alluded to, and made with the view to aid the superphosphate makers. The native phosphate alluded to contains, on an average, in 100 parts:—Sand, 0·93; phosphoric acid, 38·32; total lime, 48·92; water (driven off at red heat), fluorine, chlorine, carbonic acid, oxides of iron and manganese, &c., together, 11·83; tribasic phosphate of lime, corresponding to the phosphoric acid, 83·3; excess of lime, 3·94.

Phosphate of Lime Deposits near Saint-Antonin and Caylux.—M. Trutat.—A geological paper, containing the record of the author's researches on the spot alluded to, and a communication on the probable origin of this deposit as due to organic anima remains.

The Part which Space Plays (sur le Rôle de l'Espace) in the Phenomena of Solution.—C. A. Valson.

Action of Chlorine on the Chloride of Isopropyl.—C. Friedel and R. D. Silva.—The iodide of isopropyl has been first converted into the chloride by heating it in a sealed tube along with bichloride of mercury. The very pure chloride of isopropyl thus obtained has been submitted to the action of chlorine, aided by direct sunlight; the two principal substances thereby obtained are liquids, one of which boils at 70°, the other at 96°; the sp. gr. of the former at 0° = 1·1125, and of the latter, 1·182; their formula is $C_3H_6Cl_2$.

Derivatives from the Chloride of Tollylen.—E. Grimaux.—The author states that he has tried to obtain the monochloride of tollylen by causing alcoholic caustic potassa solution to act upon the chloride (obtained by the action of chlorine upon methyl-toluen, C_8H_{10}), but, instead of the body the author expected to obtain, he got mono-ethyline of tollylenic glycol, $C_{10}H_{14}O_2$, by a reaction which is represented by the following formula:—

$$C_8H_8Cl_2+KOH+C_2H_5OK=C_8H_8\left\{\begin{matrix}OC_2H_5\\OH\end{matrix}\right\}+2KCl.$$

The substance alluded to is a limpid liquid, having an agreeable odour; it is insoluble in water, soluble in alcohol and ether, boiling at about 252°. Nitrated chloride of tollylen—

$$C_8H_7(NO_2)Cl_2=C_6H_3(NO_2)\left\{\begin{matrix}CH_2Cl\\CH_2Cl\end{matrix}\right.$$

is a solid crystalline substance, fusing at 45°; it is very soluble in ether, also in alcohol; by the action of a concentrated aqueous potassa solution upon the chloride of tollylen there is formed a yellow-coloured substance, insoluble in all solvents, fusing at 275°.

Researches on the Physiological Properties of Various Metallic Chlorides.—Dr. Rabuteau.—A very important contribution to pharmaco-dynamics.

Combustibility of Carbon.—Dr. Dubrunfaut.—The author holds that carbon cannot burn unless by the influence of water, which is converted thereby into hydrogen and oxide of carbon, and further maintains that, as regards the phenomenon of combustion of carbon in dry oxygen gas, we are not acquainted either with pure or with dry gases.

Quantitative Estimation of Glucose.—F. Jean.—After first referring to the researches of Drs. Millon and Commaille on the reciprocal action of the proto-salts (red oxide) of copper and those of silver, the author communicates the following reaction:—1 decigrm. of sugar having been first converted into glucose, and this having been added to a solution of the double cupro-tartrate of potassa, the mixture is next boiled, whereby a precipitate of red oxide of copper is produced: this is then dissolved in hydrochloric acid, and next over-saturated with ammonia. The liquid so obtained is poured into ammoniacal nitrate of silver solution, whereby a precipitate of metallic silver is thrown down, which, having been weighed (the assay has been tried several times), is found to yield a result quite satisfactory for all purposes, because, while theory requires 0·315, the author obtained (with 1 decigrm.) 0·316, 0·315, 0·314, &c. 1 equivalent of glucose corresponds to 5 equivalents of metallic silver, or 100 glucose to 300 silver, and 100 cane sugar to 316 silver.

December 18, 1871.

This number contains, in addition to several very interesting papers on meteorology, the following original papers relating to chemistry and allied sciences:—

Memoir on Dr. J. von Liebig's Essay on Fermentation.—M. Pasteur.—Notwithstanding the intrinsic value of this very lengthy paper, it is not well suited for any useful abstraction.

Influence of Various Colours upon Vegetation.—P. Bert.—From this very important phyto-physiological essay we learn that the use of coloured glass bell-jars and coloured glass panes in hothouses is absolutely injurious to vegetation, and that plants only thrive healthily by obtaining a plentiful supply of white light (ordinary day- and sunlight).

Dolerite Met with in the Bergonne (a District of the Auvergne in France) Limestone Deposit, and on the Zeolites Found in that Locality.—F. Gonnard.—A mineralogical essay. We meet here with the results of the chemical analysis of the mesol from Gignat (the name of a village); that mineral contains, in 100 parts:—Silica, 42·3; alumina, 28·1; lime, 10·0; soda, 6·7; potassa, a trace; water, 14·1; total, 101·1.

Complex Nature of Cathartine.—E. Bourgoin.—After first referring to the researches made by Lassaigne and Fennelle in 1821 on the senna leaves, and allusion being made to the cathartine then discovered and considered to be the active principle of the drug alluded to, the author states that, having occasion to prepare cathartine, he has, on experimenting with it, found it to be made up of chrysophanic acid, a dextrogyre glucose, and chrysophanine. The cathartine, prepared as described by Lassaigne and Fenuelle, is first treated with ether, whereby the chrysophanic acid is eliminated; next, the residue is treated with water, whereby the dextrogyre glucose is dissolved; the chrysophanine is best obtained by treating the cathartine first with ether, next dissolving it in water, and precipitating that solution with acetate of lead, the chrysophanine combining with lead, and being set free by treating this lead compound with sulphuretted hydrogen. When, however, it is desired to obtain a large quantity of chrysophanine, it is best to work with a strong senna infusion, from which the mucilage is thrown down by means of alcohol, the clear solution next treated with neutral acetate of lead solution, further treatment with sulphuretted hydrogen, filtration, evaporation of the clear liquid to syrupy consistence, and precipitation with alcohol at

90 per cent; the precipitate (crude chrysophanine) is purified by means of alcohol, until that liquid runs off colourless. The properties of chrysophanine will be described by the author in another paper.

Bayerisches Industrie und Gewerbe Blatt, October, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

International Exhibition at Moscow.—A. List.—This paper contains some particulars on the subject just mentioned. The exhibition will be opened on May 30 next, the 200th anniversary of the birth of Peter the Great; the scope and arrangement of this display is, in many respects, similar to the exhibition held at Amsterdam some years ago.

Continuation of the Report on the Swabian Exhibition Held at Ulm (1870).—A. Fischer.—This portion treats on metallic industry and engineering works; industry of textile fabrics; articles of food and diet; musical instruments and fine arts.

Revivification of Bone-Black in Sugar Refineries by the Aid of Ammonia, and the Use of a Peculiar Apparatus whereby the Re-Burning of the Bone-Black is Avoided.—Dr. H. Eisfeldt and C. Thumb.—This lengthy memoir, illustrated by a series of engravings, contains, in the first place, a detailed account of the various methods of bone-black revivifying and the *rationale* thereof, and, next, a complete description of the process and apparatus of the authors. From the summary review added to this essay, it appears that this plan of revivifying bone-black (it has been tried for some years already on the large scale in a few sugar works) is better and cheaper than any other.

Annales des Mines, No. 4, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Memoir on some Minerals Found along with Smithsonite in the Mineral Deposits of Nador, Province of Constantine.—M. Flajolot.—Nadorite is a new mineral, $Sb_2O_2Cl.2PbO$; sp. gr. = 7·02; it is crystalline, readily soluble in hydrochloric acid, and contains, in 100 parts:—Lead, 51·60; antimony, 31·55; oxygen, 8·0; chlorine, 8·85. Antimonio-carbonate of lead; in 100 parts:—$Sb_2O_2Cl.2PbO$, 12·05; $Sb_2O_5.PbO$, 58·0; $CO_2.PbO$, 26·0; HO, 3·95. Antimoniate of iron, $Sb_2O_5.Fe_2O_3+1\frac{1}{2}HO$; in 100 parts:—Antimonic acid, 63·50; sesquioxide of iron, 31·40; water, 5·10. Arseniate of lead with chloride of lead; in 100 parts:—Arsenic acid, 18·30; oxide of lead, 53·60; chloride of lead, 8·55; carbonate of zinc, 13·50; carbonate of manganese, 1·10; carbonate of lead, 1·70; carbonate of magnesia, 0·70; oxide of iron and quartz, 2·20. Multiple clayey carbonate *(carbonate multiple argileux)*, a hard schistose mineral, perfectly homogeneous; in 100 parts:—Carbonate of protoxide of iron, 28·50; carbonate of zinc, 43·03; carbonate of protoxide of manganese, 5·10; carbonate of lime, 2·05; carbonate of magnesia, 2·10; hydrated alumina (alumina, 17·00; water, 2·20), 19·20. Smithsonite is calamine, a zinc ore which occurs in many districts of Algeria.

Metallurgy of Silver in Mexico.—P. Laur.—An exhaustive and very complete treatise on this subject. The author, having spent several years in the country alluded to, has obtained the best and really reliable information, also by locally viewing mines and smelting works attached thereto.

Polytechnisches Journal von Dingler, first number for December, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Extraction of Peat from Peat-Bogs according to the Diesbach System.—Baron von Lameran.—This paper, illustrated by engravings, contains a detailed description of a very important mode of working peat-bogs advantageously.

Part which Carbon Plays in the Making of Moulds for Iron Castings.—A. Ledebur.—This part contains a very excellent account of the iron-foundry industry.

Baryta Glass.—Dr. H. E. Benrath.—This lengthy essay treats on the chemistry of glass manufacture, and more especially on the use of baryta as a constituent of the glass mass; when in ordinary window-pane glass, $NaO,CaO6SiO_2$, baryta is substituted for a portion of the alkali, and some litharge added instead of lime, and this be done so that, according to equivalents, one-third of the alkali and half of the lime are left out, we obtain a glass mass, composed according to the formula—

$$(6KO+6CaO36SiO_2)$$
$$4KO,2BaO,3CaO,3PbO36SiO_2$$

The percentage composition of a glass mass made according to the lower formula will be—Silica, 60·0; oxide of lead, 16·6; lime, 4·6; baryta, 8·4; potassa, 10·4 (these two being equivalent to 14·3 potassa). The author communicates the results of a series of experiments made on the large scale, and elucidated by analysis. It appears that the celebrated glass manufacturer, P. Regout, at Maestricht, uses the following mixture for the production of an excellent and very brilliant glass:—Sand, 300 parts; potash, 80; nitrate of potash, 10; witherite (native carbonate of baryta), 40; limestone, 40; red-lead, 80.

Studies on Portland Cement.—F. Schott.—Notwithstanding the intrinsic value of this very exhaustive essay, its contents are not suited for useful abstraction; a remark equally applying to the following paper:—

Direct Manufacture of Ultramarine by One Calcination Process.—C. Furstenau.—Illustrated with engravings.

Decomposition of Nitro-Sulphuric Acid (Crude Sulphuric Acid which Contains Nitric and Nitrous Acids in Solution) by the Aid of Glover's Column, and on the Concentration of Sulphuric Acid to 60° B. Combined therewith.—F. Bode.—A critical review on the subject mentioned. The author partly approves of the arrangement, but says that, as long as it is possible to concentrate chamber acid by the heat of the pyrites-kilns, Glover's plan is not commendable in practice.

New Method of Estimating the Value of Aniline Dyes.—A. Muller.—The author describes at great length a process of testing the aniline dyes, based upon the fixation of the dye to be tested on a piece of plate glass by means of collodion, so as to form a thin layer of the dye under examination, which is then compared with a normal dye similarly prepared.

Composition of a so-called Infusoria Earth Recently Found near Altenschlirf (Hesse-Darmstadt).—Dr. Tasche.—The earth, dried at 100°, contains, in percentages:—Silica, 91·5; oxide of iron, 0·5; water and organic matter, 8·0.

Use of Olive Oil for the Purpose of Purifying the Carbonic Acid Evolved from Common Limestones, and also for the Purpose of Absorbing the Empyreumatic Matters by the Preparation of Liquid Ammonia from Tar-Water in Gas Works.—E. Pfeiffer.—The olive oil, partly imbibed by lumps of pumice-stone, and partly in fluid state, is used for the purposes alluded to, in order to retain empyreumatic matter which contaminates carbonic acid prepared from some kinds of limestones, and also to retain the empyreumatic products which are carried off when tar-water (ammoniacal liquor of gas works) is boiled for the purpose of producing liquid ammonia. The olive oil may be repeatedly used, for after having been strongly heated it loses the products it had absorbed, and the oil is at last always valuable for making cart-grease.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 18. 1871.

This number, published on January 8th inst., contains the following original papers and memoirs:—

The Affinity of Hydrogen for Chlorine, Oxygen, and Nitrogen.—J. Thomsen.—We regret that the contents of this very important essay do not omit of any useful abstraction. The following are the headings of the chapters into which this memoir is divided:—Affinity of hydrogen for chlorine; affinity of hydrogen for oxygen; affinity of hydrogen for nitrogen.

Synthetical Experiments on the Uric Acid Group.—O. Jacobson and A. Emmerling.—This lengthy memoir contains the following sections:—Action of cyanogen upon dry ammonia; action of water upon hydrazulmin at the ordinary temperature of the air; action of cyanogen upon aqueous ammonia; alteration which hydrazulmoxin undergoes by the action of hot water: synthesis of mycomelinic acid, oxidation of hydrazulmoxin; constitution of azulminic and mycomelinic acids, and of other uric acid derivatives.

Substitution of Aromatic Amines.—V. Meyer and O. Stüber.—This essay treats on the following question:—Since by the bromising (*Bromirung*) of aniline and acetanilid there is formed the 1·2 brom-aniline, and since this compound is converted into dibromaniline, what is the constitution of the last-named compound? The contents of this paper, illustrated by complex formulæ, belong to the domain of constitutional chemistry.

On Tribrom-Aniline.—O. Stüber.—Tribrom-aniline, obtained by treating hydrochlorate of aniline with bromine, was gradually, and by small portions at a time, put into alcohol previously saturated with nitrous acid; hereby a strong reaction ensues, nitrogen and aldehyde being copiously disengaged, while, after cooling of the warm liquid, a crystalline solid body is obtained, which, by being re-crystallised from boiling alcohol, becomes colourless, exhibiting a substance fusing at 118·5°, difficulty soluble in cold alcohol, and not very largely so in that liquid when boiling. On being analysed, the composition of this substance was found to be identical with that of tribrom-benzol, but the position of the bromine atoms in this tribrom-benzol differs from that of the only hitherto known tribrom-benzol, which fuses at 44°.

Action of Nitrous Acid Ether upon Benzamide.—V. Meyer and O. Stüber.—When the aromatic amines are introduced into alcohol which has been previously saturated with dry nitrous acid (consequently, a solution of nitrous acid ether in alcohol), the group NH_2 of the amine is eliminated, and hydrogen directly substituted for it; taking aniline as an instance, this reaction may be elucidated by the following formula:—

$$C_6H_5.NH_2+NO.OC_2H_5=N_2+C_2H_4O+H_2O+C_6H_6.$$

By causing benzamide to react upon absolute alcohol, previously saturated with dry nitrous acid at 120° in a sealed tube, the result is the formation of benzoic ether and nitrogen, this reaction taking place according to the following formula:—

$$C_6H_5.CO.NH_2+NO.OC_2H_5=N_2+H_2O+C_6H_5.CO.OC_2H_5.$$

On Chloral.—V. Meyer and L. Dulk.—This very lengthy essay, elucidated by a series of complex formulæ, is divided into the following sections:—Introduction; action of chloracetyl upon chloral-alcoholate; acetyl-chloral-alcoholate is a colourless, oily liquid, exhibiting a pleasant smell, boiling at 198°; sp. gr. at 11° (as compared with water at the same temperature) = 1·327, formula; $C_6Cl_3H_9O_3$; action of acetic acid anhydride upon chloral.

On Tannic Acid and Some of its Derivatives.—H. Schiff.—The author first states that he has confirmed the observation made by Dr.

Löwe some time ago, that arsenic acid converts at boiling heat aqueous and alcoholic solutions of gallic acid into tannic acid, while the arsenic acid is thereby left unchanged, unless the reaction takes place between the dry substances (gallic and arsenic acids) at a temperature of from 120° to 160°, when the arsenic acid is converted into arsenious acid; tannic acid thus prepared in its pure state has been further investigated by the author, who describes at great length and elucidates his experiments by a series of formulæ.

Preliminary Notice.—E. Ludwig.—Since H. Salkowski is, according to a paper published by him lately, engaged with experiments on the chinon-like derivatives of naphthol, a subject which is studied likewise by the author, we are informed that for the hydroxyl group in these bodies can be substituted the group NH_2 by the action of ammonia; oxynaphthochinon ($C_{10}H_5.O_2.OH$) yields by being treated at from 100° to 110° with aqueous or ammonia solution amidonaphthochinon ($C_{10}H_5.O_2.NH_2$).

On Amido-Benzo-Sulpho Acid.—L. Pratesi.—The remnant of the dry distillation of a combination of sulpho-phenol acid and aniline yields to water a substance which, on being further investigated, is a body with acid reaction, and forming salts with potassa, soda, oxides of lead and copper, and, by treatment with bromine, tribromaniline; this compound is, therefore, amido-benzol-sulpho acid,

$$C_6H_4 \left\{ \begin{matrix} NH_2 \\ SO_3H. \end{matrix} \right.$$

On Aurin.—R. S. Dale and A. Schorlemmer.—Second paper on this subject. Aurin very carefully purified and dried at 200° has the formula $C_{20}H_{11}O_3$, and accordingly its mode of formation may be elucidated by the following formula:—

$$3C_6H_6O + C_2O_2 = C_{20}H_{11}O_3 + 2H_2O.$$

Pure leukaurin is best obtained by the action of powdered zinc upon an acetic acid solution of aurin; the formula of leukaurin is $C_{20}H_{16}O_3$. Aurin forms a compound with sulphurous acid and with the alkaline sulphites, while, when aurin is heated to 140° along with alcoholic ammonia solution, so-called red coralline is obtained in beautifully crystalline shape.

From the report of the proceedings of the General Annual Assembly of the German Chemical Society at Berlin we learn that the number of members (Fellows) on the 14th of December last was 720, of whom 136 reside at Berlin; the financial position of this Society is excellent.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, September and October (double number), 1871.

This number does not contain any original papers relating to chemistry.

NOTES AND QUERIES.

Sprengel Mercurial Pump.—(Reply to "M.")—See CHEMICAL NEWS, vol. xvii., p. 85. Also *Journal of the Chemical Society*, 1865.

Paraffin Oil and Paraffin Refining.—"M. P. S." will find the most useful information on these subjects in the latest edition of Ures "Dictionary of Arts," I think under the various headings of Paraffin, Photogen, &c., but in no book will he get any but a very faint idea of how the thing is done practically.—CHEMICUS.

Olive Oil Residues.—"Oleum" wishes to know where and how he can obtain olive oil residues. I paid some attention to this subject while in Italy, and found it a most difficult material to remove to any distance, as after pressure in that climate fermentation so soon sets in. In one province in South Italy, 30,000 tons of this residue may be obtained, containing, amongst other products, stearate and margarate of glycerine.—T. COBLEY.

Phenyl-Citramic Acid.—I find in Naquet's "Chemistry," that phenyl-citramic acid contains the elements of—

$$(C_{12}H_5O_{10})(C_{12}H_5)H,N_2.$$

I fancy it should be one N instead of N_2. Will any one having a French edition kindly state what is the notation given.—S. E. P.

Paraffin at High Boiling-Point.—Can you or some one of your numerous readers inform me, through the medium of your "Notes and Queries," what the name is of a certain paraffin oil (mentioned in one of your former numbers) that will bear a temperature of 1100° F., without boiling or decomposing; also where I can obtain some. I think it was discovered about June or July, 1870.—MEDICUS.

Softening Water by means of Lime.—In the "Chemical Notices from Foreign Sources" in the issue of the 12th inst., is a short *precis* on this subject. May I enquire price of the journal in which it appears (*Polytechnisches Journal von Dingler*), and where a copy can be obtained? With the late Dr. Clark's patented process of treating water containing carbonates with lime I am well acquainted; can your readers tell me if it has ever been attempted successfully to treat waters hard from gypsum and magnesic sulphate, and if any scheme for the purpose has been patented?—W. R.

A. H. Elliott's Method for Sulphur in Cast-Iron.—(Reply to S. Peters).—I used this process along with Wöhler's chlorine method, and also the method in which $CuCl_2$ is used and the C burnt in O, and I found it more easy to work, and that it gave more concordant results, than either of these; the precautions published in my paper were all that I found it necessary to attend to. The samples of iron that I worked with did not contain much combined carbon. With regard to the residual sulphur not evolved as H_2S, this will be found to be practically nothing if he weighs the $BaSO_4$. With regard to the questions about vanadium and titanium, my experiments did not lead me in their direction.—A. H. ELLIOTT.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 22nd.—Royal Geographical, 8.30.
—— London Institution, 4. Prof. Odling, F.R.S., on "Elementary Chemistry."
TUESDAY, 23rd.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
WEDNESDAY, 24th.—Geological, 8.
—— Society of Arts, 8.
THURSDAY, 25th.—Royal, 8.30.
—— Philosophical Club, 6.
—— London Institution, 7.30. Prof. Ella, "On Devotional and Dramatic Music."
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
FRIDAY, 26th.—Royal Institution, 9. The Archbishop of Westminster, "On the Demon of Socrates."
—— Quekett Microscopical Club, 8.
SATURDAY, 27th.—Royal Institution, 3. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

TO CORRESPONDENTS.

G. G.—The English edition of Wagner's "Chemical Technology" will shortly be published by Messrs. J. and A. Churchill.

S. O. Hoffmann.—Received.

Chemicus.—(1). It is made from the Stassfurt mineral. (2). It depends entirely upon the water used. (3). Dry sifted ashes are sometimes employed.

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THE
MANUFACTURE OF CHLORINE.

ALTHOUGH the development of the process for the Manufacture of Chlorine by means of oxides of manganese regenerated by means of magnesia, to which reference was made on this page some months ago, has been sorely delayed by serious ill-health on my part, I am nevertheless in a position to announce that that process, in a certain modified form which it has now assumed, has proved capable of yielding even more advantageous results than I formerly claimed for it. It will necessarily be yet some time before I can be able or free to supply working details. Meanwhile, I beg to report as follows :—

I. That the new form of process yields, in the free state, practically *all* the chlorine contained in the salt decomposed, being at about the rate of *a ton of bleaching-powder per fourteen hundredweights of salt.*

II. That, of the chlorine which it thus yields, a sufficient proportion to give a ton of bleaching-powder for about each thirty hundredweights of salt is ENTIRELY UNDILUTED, and therefore available for the manufacture of bleaching-powder in the chambers at present in use. This portion of the chlorine is generated in the ordinary (Weldon) stills, and is in precisely the same condition as that produced in my process as at present practised, or as that generated by means of native manganese.

III. That, while the remainder of the chlorine is *dilute*, it is not more so than that produced in any process yielding dilute chlorine only, and is free from carbonic acid, the sole diluent being nitrogen.

IV. That the process, in its new shape, is performed without blowing engines, and *without machinery of any kind*, by appliances already in use in every alkali-work, the only thing employed in it which has any "moving parts" being an ordinary liquor-pump.

The new form of process thus yields more *strong* chlorine, per given quantity of salt, than has ever hitherto been produced by any process whatever, and, in addition, yields the remainder of the chlorine in as good a state as the richest chlorine producible by any process which yields dilute chlorine only. While permitting the present production of bleaching-powder, per given quantity of salt, to be nearly *quadrupled*, it enables one-half of the quadrupled production to be made from undiluted chlorine, in such chambers as have been employed hitherto, and one-half of the chlorine to be generated in the present stills. Putting the whole cost of the process on the *strong* chlorine only, the cost of the latter, per ton of bleaching-powder, promises to be lower than it has ever been yet, the other half of the chlorine counting as not costing at all. Lastly, the special plant required for the new form of process is so simple and inexpensive. that the cost of a plant for any considerable production will probably not exceed £20 for each ton of bleaching-powder to be made by it per week.

WALTER WELDON.

Offices of WELDON'S CHLORINE PROCESSES COMPANY, (Limited),
59, Lincoln's Inn Fields, London, W.C.

December 12th, 1871.

THE CHEMICAL NEWS.

Vol. XXV. No. 635.

ON THE
REACTION OF CHLORAL HYDRATE AND SULPHIDE OF AMMONIUM.*

By Dr. I. WALZ.

In 1847 Liebig and Wöhler obtained a peculiar crystalline and well-defined base, called thialdine, by passing a current of sulphuretted hydrogen through a solution of aldehyde-ammonia. It was to be expected that in a similar manner an analogous substance might be obtained from the action of sulphuretted hydrogen upon a solution of chloral hydrate in ammonia, or, what amounts to the same thing, of sulphide of ammonium upon a solution of chloral hydrate. In fact, Staedeler announced in the form of a preliminary communication that he had succeeded in isolating this substance; but since that, nothing has been published upon the subject, as far as I am aware.

About a year ago I made a number of experiments in this direction, which have not led to any very satisfactory results, and which I am only induced to communicate because I am in hopes that they may lead to a simple and easy test for the purity of chloral hydrate, which, in view of repeated recent accidents consequent upon the administration of this preparation, would be highly desirable. And in this place let me protest against the uniform neglect, in nearly all the cases reported, of a chemical examination of the suspected medicine. I am far from asserting that the medicinal use of even pure chloral hydrate may not, in certain diseases, or to certain constitutions, prove deleterious; but it would certainly go far towards a definite settlement of this disputed question, if, in a number of authenticated cases, the degree of purity of the chloral administered were ascertained by chemical tests. In this, as in many other cases, science and humanity would be greatly benefited by a closer cooperation between the physician and the chemist.

The chloral hydrate which I used at first in my experiments was of American manufacture, a little moist as it came from the factory, and was kept in my laboratory in a glass-stoppered vial during almost the whole of the unusually warm summer of last year. Unfortunately, I had no reason to suspect it till it was all used up. I dissolved it, in several portions, and at different times, in about 15 to 20 times its weight of water, to which a little ammonia had been added, and as soon as the solution had been effected, I added an excess of sulphide of ammonium. The liquid assumed a reddish-brown colour, and an abundant yellow precipitate was formed. This was thrown upon a filter, washed with cold water, and dried over sulphuric acid. It then formed a light yellow, impalpable powder, which became electric when rubbed in the agate mortar. It is insoluble in dilute acids, alkalies, and alkaline sulphides, sparsely soluble in alcohol, ether, bisulphide of carbon, and turpentine. When boiled with hot alcohol it seems to undergo partial decomposition, as crystals of sulphur were obtained from the solution. Concentrated sulphuric acid dissolves it; by the addition of water it is precipitated unchanged. Concentrated nitric acid oxidises it rapidly, forming at the same time a volatile oil of very pungent odour, and powerfully irritating to the eyes. It seemed to be most soluble in chloroform, from which solution it was obtained as a yellow resinous crust. When heated in a porcelain crucible, a heavy dark yellow oil of very disagreeable odour comes off, a shining, black, porous coal remaining behind. I could not analyse it for want of material; but it appeared to be a well-defined substance, and when I shall obtain suitable material I will prepare it again, and subject it to analysis. In the meantime I will state that O. Loew asserts, that in physical appearance and chemical properties it resembles exactly the sesquisulphide of carbon, which he described in the *American Journal of Science*, xli., 363.

In order to obtain a larger quantity of this substance, I procured from Dr. P. Schweitzer a sample of chemically pure chloral hydrate of his own preparation. With this, the result of the sulphide of ammonium reaction was quite different. The liquid turned red, then rapidly brown and thick, depositing, in the course of 24 hours or longer, a glutinous, dirty brown substance. If, however, the liquid is acidulated soon after the commencement of the reaction with hydrochloric acid, a grayish-brown flocculent precipitate is obtained, mixed with sulphur. This precipitate, dried over sulphuric acid, is a harsh powder, and the raw substance contained in it difficult to obtain pure. Chemically, it seems to be closely related to the yellow sulphydrine above described. The filtered hydrochloric acid solution has an agreeable odour of stewed kidneys, and, on standing, deposits an orange or dark yellow substance, related to the two former.

There can be no doubt that the chloral hydrate which I had at first was either impure or decomposed by moisture, heat, or light. I would request those who may have occasion to test chloral hydrate, to apply the sulphide of ammonium, in order to ascertain whether the reactions described are sufficient to establish the purity or impurity of the substance. The reaction may be made in a test-tube, and with a comparatively small quantity of the chemical.

ASSAY FOR GOLD AND SILVER.

By T. M. BLOSSOM, E.M.,
Assistant in charge of the Assay Laboratory of the School of Mines, Columbia College.

(Continued from vol. xxiv., p. 270).

II. Assay of Alloys.

1. *Silver Coin and Bullion.*

The form of assay used for silver coin and bullion is that known as Gay-Lussac's Wet Method, which consists in determining the fineness of the alloy by the quantity of a standard solution of common salt necessary to precipitate, fully and exactly, the silver contained in a known weight of alloy.

The process embraces two steps—

A. Preliminary Assay, and *B.* Assay Proper.

The latter requires for its conduct the preparation of three solutions called—*Normal Salt*, *Decime Salt*, *Decime Silver*.

Normal Salt Solution.—This is a solution of common salt of such a strength that 100 c.c. will precipitate exactly 1 grm. of silver. (Preparation below).

Decime Salt Solution.—This is a solution of common salt only 1-10th the strength of the former, *i.e.*, 100 c.c. will precipitate exactly 0·1 grm., 1 c.c. will precipitate 1 milligramme of silver. The solution is made by diluting 1 part of the *normal salt* with nine parts of pure water.

Decime Silver Solution.—Dissolve 1 grm. pure silver in nitric acid, and dilute to a litre. 1 c.c. of the solution will contain 1 milligramme pure silver. The *decime silver* is equivalent to the *decime salt*, *i.e.*, if mixed in equal quantities they will mutually suffer complete decomposition.

Preparation of the Normal Salt Solution.—A large quantity of the solution is prepared at one time and prepared at one time and preserved in a suitable vessel, partially closed in such a manner as to prevent any alteration in the strength of the solution through loss of water by evaporation. Let us suppose that a common glass

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* Read before the Lyceum of Natural History of New York.

carboy, of 60 litres capacity, is employed, and that it has affixed to it a scale, carefully graduated, to indicate its contents at any time. We will add only 45 litres of water, in order to leave sufficient room for agitation of the solution after the addition of salt. How much salt must be added to 45 litres of water to make the solution of the required strength? If pure salt be employed, the answer is easily found by the following proportion:—

108 : 58·5 : : 45 × 10 : x = 243·75 (grms.) = wt. of pure salt.

Pure salt, however, is difficult to procure, and alters rapidly by the absorption of moisture, so that we generally employ a concentrated solution of common salt. The quantity of salt it contains may be ascertained by evaporating a portion to dryness. Let us suppose that 100 c.c. of the concentrated solution contains 35 grms. of salt. We require, as found by the above proportion, 243·75 grms. pure salt for 45 litres pure water.

(223·75 ÷ 35) + 100 = 696·29 = number of c.c. salt solution.

Since, in adding the salt, we also introduce 696·29 c.c. water, we will put into the carboy 45 litres less 696·29 c.c., or 44 litres, 304 c.c. water. The water and salt solution having been introduced, they must be well mixed by means of an agitator. The tubes and pipette are washed out several times by allowing the solution to run through them; the solution so passed is returned to the reservoir, and the contents are agitated after each addition. The solution is now tested and accurately standardised. We have prepared for this purpose three or four solutions of silver in nitric acid, called check-assays, each containing 1 grm. pure silver. The solutions are made with strong acid in glass-stoppered bottles of 8 oz. or 250 c.c. capacity. The stoppers must fit perfectly, to prevent loss of solution on shaking the bottles. Prepare also a temporary decime salt solution by diluting 25 c.c. of the normal salt solution with nine times the quantity or 225 c.c. of water. This will not be exactly equivalent to the decime silver solution, but the error is very slight, and may be disregarded.

For the sake of convenience, we consider the pipette of 100 c.c. to be divided into 1000 parts. Since 100 c.c. = 1 grm. pure silver, 1 thousandth will correspond to 1 milligramme silver, and will equal in strength 1 c.c. of the decime salt solution. Cubic centimetres of the decime salt and the decime silver are also called thousandths, because the former equal, and the latter correspond to, thousandths of the normal solution.

Run into one of the check-assays 100 c.c. of the normal solution, agitate, and allow the precipitated chloride of silver to subside. Repeat the agitation, if necessary, until the solution settles clear and bright. Add now 2 thousandths of the decime salt solution. Since the common salt contains impurities, there will not be enough salt in 100 c.c. of the normal solution to precipitate 1 grm. silver, and the decime salt will produce further precipitation. Agitate as before, and, when the solution becomes clear, add again 2 thousandths decime salt, and repeat the operation until a precipitate fails to appear on the addition of the salt solution. Suppose we have added altogether 16 thousandths. The last two produced no precipitate and are not counted. The two preceding thousandths were needed only in part, so that the acting thousandths were above 12 and below 14, or 13 in number. Thus 1013 parts of the normal solution are required to precipitate 1 grm. silver, while only 1000 should be required. The solution is too weak, and the quantity of salt solution to be added may be found by considering that 696·29 c.c. have produced a standard of only 1000 − 13 or 987 thousandths. It remains to provide for the 13 thousandths. The additional quantity of salt solution required is found by the following proportion,—

987 : 696·29 : : 13 : x = 9·2 c.c.

9·2 c.c. of the concentrated salt solution are added to the reservoir, and the contents are well mixed. The tubes and pipette are washed out with the new solution, and another test is made precisely as before, except that we add 1 thousandth of the decime salt, at a time, instead of 2 thousandths. Suppose we have added 2 thousandths of the decime salt, the first one alone producing a precipitate. We require then somewhere between 1000 and 1001 parts of the normal solution, or about 1000·5. Add 2 thousandths of the decime silver solution. These will decompose the excess of salt solution, or 1·5 thousandth, and leave 0·5 thousandth decime silver in excess. Add 0·5 thousandth decime salt; this will give a precipitate, but a second 0·5 thousandth fails to produce one. We require of the normal solution, therefore, a number of thousandths between 1000 and 1005·5, or 1000·25, which gives a standard of 100 − 0·025 = 999·75, which may be considered sufficiently near for most purposes.

Greater accuracy may be obtained, if desired, by adding a fresh supply of salt solution as indicated by the proportion—

999·75 : (696·29 + 9·2) : : 0·25 : x = 0·2 c.c.

A new decime solution of salt is made from the standardised normal solution.

A.—*Preliminary Assay.*

This is a simple cupellation of the alloy with pure lead, to determine the approximate fineness. If we know the latter, this assay is, of course, unnecessary. It is rendered necessary in all other cases, by the fact of our employing in the assay proper, a constant volume of normal salt solution corresponding to 1 grm. pure silver, so that we must take such a weight of the alloy as will contain at least 1 grm. pure silver. The preliminary assay enables us to calculate this weight.

Pure lead-foil is kept, for gold and silver bullion, in small sheets about 2 inches square, weighing $\frac{17}{100}$ oz., or 5·287 grms. each. Weigh out 1 grm. of the alloy, wrap it up in a whole sheet of lead, and cupel in the ordinary manner. Suppose we obtain a button of silver weighing 0·8695 grms.; then—

1 : 0·8695 : : 1000 : x = 869·5 = approx. fineness.

This must be corrected for the unavoidable losses of a fire-assay. The following table, from Mitchell, gives the corrections to be made in the different standards, as found by cupellation. The corrections are given in thousandths, and are in all cases to be added to the standard by cupellation.

Table of Corrections for Loss in Cupellation.

Standard.	Corr.	Standard.	Corr.	Standard.	Corr.
998·97	1·03	670·27	4·73	346·73	3·27
973·24	1·76	645·29	4·71	322·06	2·94
947·50	2·50	620·30	4·70	297·40	2·60
921·75	3·25	595·32	4·68	272·42	2·58
896·00	4·00	570·32	4·68	247·44	2·56
870·93	4·07	545·32	4·68	222·45	2·55
845·85	4·13	520·32	4·68	197·47	2·55
820·78	4·22	495·32	4·68	173·88	2·12
795·70	4·30	470·50	4·50	148·30	1·70
770·59	4·41	445·69	4·31	123·71	1·29
745·38	4·52	420·87	4·13	99·12	0·88
720·36	4·64	396·05	3·95	74·34	0·66
695·25	4·75	371·39	3·61	49·56	0·44
				24·78	0·22

The number in the column of standards next nearest to 869·5 is 870·93, and the corresponding correction is 4·07: adding this to 869·5 we obtain 873·57 for the true approximate fineness. The difference between any two successive corrections being a small amount, it will be sufficient, in most cases, to take the correction for the next nearest number, when the exact standard is not found in the table. If greater nicety be desired, a third column of differences, as in logarithmic tables, may be constructed from the above table.

B.—*Assay Proper.*

Take such a weight of the alloy as will contain 1 grm. pure silver. This is found from the approximate fineness and by the following proportion:—

873·57 : 1000 : : 1 : x = 1·145 (grms).

Having weighed out this amount, place it in a glass-stoppered bottle of 8-oz. capacity, and dissolve in about 10 c.c. nitric acid. Heat gently on the sand-bath to facilitate solution. Add 100 c.c. normal salt solution, and proceed as in testing the normal solution, until the decime salt fails to give a precipitate. Suppose we have added 6 thousandths of the decime salt. The last gave no precipitate, so that we required more than 4 and less than 5, or 4·5 thousandths. If greater accuracy be desired, proceed as follows:—Add 1·5 thousandths decime silver solution; this will decompose 1·5 thousandths of the decime salt which were added in excess; we know that 4 thousandths decime salt were required in totality; the fifth gave a precipitate, but was only required in part; we have decomposed the sixth and half the fifth by an addition of 1·5 decime silver; if now we add 0·5 thousandth decime silver and obtain a precipitate, we know that we required between 3 and 4·5 or 4·25 thousandths decime salt. If we obtained no precipitate with the half thousandth of silver, the first calculation of 4·5 would thus be proved correct. Suppose, however, that we obtained a precipitate; the number of thousandths salt solution required would be 1000 (normal) +4·25 (decime) = 1004·25, *i.e.*, the weight of alloy taken contained exactly 1004·25 milligrammes, equal to 1·00425 grms. of fine silver. The fineness is given by the following proportion:—

1·145 : 1·00425 :: 1000 : x=877·07 (fineness).

(To be continued).

RELATION BETWEEN THE SPECIFIC HEAT AND THE ATOMIC WEIGHT.

By P. H. VANDER WEYDE.

Dulong and Petit were the first who, in 1819, pointed out the curious fact that, when the numbers representing the specific heat of elementary substances were multiplied with those representing their atomic weights or chemical equivalents, products are obtained which are equal to within a small fraction. So taking the specific heat of the substances mentioned, and muitiplying it with their atomic weights, we obtain the following table:—

Elementary substance.	Specific heat.	Atomic heat.	Product of number of the two former columns.
Mercury	0·033	100	3·30
Gold	0·032	98	3·13
Silver	0·057	54	3·07
Copper	0·095	32	3·04
Iron	0·110	28	3·08
Sulphur	0·200	16	3 20

If the value of atomic weights of many substances are doubled, as for good reasons is done at the present day, the products are, of course, also double that given in this table and all approximately = 6, in place of nearly =3, as is here found to be the case.

A similar relation to that which Dulong and Petit discovered for the elementary substances was found by Neuman in 1831 for compounds; for instance, in the case of sulphates and carbonates, he found for the following minerals:—

Mineralogical name.	Chemical name.	Specific heat.	Atomic weight.	Product.
Anhydrite	Sulphate of lime	0·185	68·0	12·6
Cœlestin	,, strontia	0·135	92·0	12·4
Heavy spar	,, baryta	0·108	116·0	12·5
Lead vitriol	,, lead	0·085	151·0	22·8
Iceland spar	Carbonate of lime	0·204	50·0	10·2
Iron spar	,, iron	0·182	58·0	10·5
Zinc spar	,, zinc	0·171	62·6	10·7
Witherite	,, baryta	0·107	98·5	10·5
White lead ore	,, lead	0·081	133·5	10·8
Strontianite	,, strontia	0·144	73·8	10·6

Two questions suggest themselves from the above details in every philosophically inclined mind. First: Are these coincidences merely accidental? Secondly: If not accidental, what do they mean? Is there some natural law at the bottom of these remarkable relations?

In regard to the first question, it must be remarked that the law appears quite general, and the exceptions very few, therefore accident is out of question; besides, the small differences in the products are easily accounted for by the fact that the specific heats differ at different temperatures, and for different physical conditions of the substances under investigation; while it is very significant that, in proportion as the experiments were made more carefully, the numbers calculated became more and more equal, as Regnault has pointed out.

In regard to the second question, as to the cause of this peculiarity, we have only to recall the numbers previously given, which show that 30 lbs. mercury, 17 silver, 10·5 copper, 8·75 iron, and 5 sulphur, possess at the same temperature the same amounts of heat; and to remark that these numbers are very nearly in proportion to one another as the respective atomic weights of the substances, 100, 54, 32, 28, and 16. As now these numbers express the combining equivalents, so that, for instance, 100 lbs. of mercury will combine with 16 of sulphur and form vermillion, and as we have reason to suppose that, in this case, like in others, each atom of mercury combines with an atom of sulphur, it is more than probable that 100 lbs. of mercury contain as many atoms as 16 lbs. of sulphur. If the number of atoms in these two quantities of mercury and sulphur is the same, and the amounts of specific heat the same, it is clear *that all atoms must possess the same specific heat*. This, now, is the law which lies at the foundation of the remarkable property explained.

When applying the modern theory, that heat is only a mode of motion, to the fact that all single atoms possess the same specific heat, it follows that it takes the same motion-producing force to increase the atomic oscillation (that means, raise the temperature) of every atom, be it mercury, sulphur, iron, or any other substance of this series of elementary substances; and that it takes a greater force (more heat) to increase the oscillation of the compound atom of a carbonate, and still more of a sulphate, &c.

"When these bodies lose their heat" means in the modern language of the conservation of force, nothing but that they communicate their atomic motion (oscillating or otherwise) to the atoms or the surrounding bodies, and put them in the same motion as they possess themselves, losing an equal amount of their own motion. Or conditions may be so arranged that this atomic motion (heat) is changed into motion of masses, commonly called force; of this arrangement, the steam-engine is the great type and example for further development.—*Scientific American*.

ON THE MANUFACTURE AND REFINING OF SUGAR.*

By C. HAUGHTON GILL.

(Continued from p. 31).

Lecture II.

After giving a brief recapitulation of the points mentioned in the previous lecture, Mr. Gill proceeded as follows:—

Time will not allow me to dwell longer on the chemical reactions of sugar, and I must now pass on, and give you an outline of the process of manufacturing sugar from the cane. As I stated last time, I have no first-hand knowledge of this process, and consequently can only give you an outline description, referring you

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* The Cantor Lectures, delivered before the Society of Arts.

to others for exact technical information. The sugar-cane, which you have all seen, either in the Botanical Gardens or represented in drawings, I need not stay to describe; it is a species of grass growing to a height of from six to ten feet. When ripe it is cut; the tops are lopped off, and the canes, tied up in bundles, are carried to the mill. The process most usually employed for extracting the juice from the cane is a very rough mechanical operation. The canes are brought up to a set of three rollers, so placed as to form two pairs, the first being set wider apart than the second, so as to only just bruise the canes, whilst they get a much severer pinch on passing through the second pair. The juice, being thus squeezed out, falls into the bed-plate of the mill, and from thence is carried to the pans in which it is clarified before being boiled down, whilst the trash or cane residue is dried and used as fuel. The juice is carried first to a series of large round vessels of about 400 gallons' capacity each, where it is brought nearly to the boiling-point, and treated with a small quantity of lime, to neutralise the acid and to assist in making the albuminous constituents set, so as to form scum which it is possible to remove. The juice, which was previously of much the same dark colour as the beet-root juice which I showed you last week, leaves these clarifiers transparent and of a more or less pale yellow colour. From these defecating pans the juice now goes to the first and largest of a series of hemispherical pans, bedded in brickwork and having a flue passing beneath them, from a furnace close to the smallest pan of the series to the chimney shaft at the other end.

The clarified juice goes, as I said first, into the largest vessel, where it is boiled until a considerable proportion of the water has been driven away. When another lot of juice is ready to come on, the contents of the pan are ladled into the second, and so it is gradually ladled from one pan into another until it comes to the smallest vessel, called a "teach," which lies immediately over the fire. By this time it has got very thick indeed, being about the consistency of treacle; and you can imagine very easily what must happen to it after all this work.

The cane juice which runs from the mill is slopping about over the place; bits of dirt, &c., have time to accumulate, and it turns a little sour; in fact, the whole juice, to begin with, is rather acid, and a portion of it begins to ferment. A change (such as that which I illustrated last week with the yeast) takes place to some extent, and a portion of crystallisable sugar is "inverted." When the juice goes into this pan it is still slightly acid, and, as I showed last week, the action of acid at a high temperature is to convert another portion of the sugar into that uncrystallisable modification, and the longer the action is allowed to go on the more sugar is thus converted. The juice is a long time passing from the first pan into the last, and therefore there is plenty of opportunity for this change to take place. Again, a high temperature is prejudicial to the sugar, as it destroys, the crystallisable power of a portion of it; and, moreover, destroys another portion altogether as sugar. When the sugar has got as far as the last and smallest pan, it is so thick that it will not boil in the open air at a temperature of less than about 230° to 235° F.; this is a temperature at which it is subject to great alteration and decomposition, and not only so, but we must also consider how much higher a temperature part of it is really being subjected to. Every mistress of a family knows perfectly well that thick things, like starch or soups, will "burn" if not kept stirred; and you can readily understand why that is. They do not move about freely enough in the pot to get heated equally throughout. The bottom of the pot gets exceedingly hot, the fire upon which it is placed being three or four times as hot as boiling water, and any liquid which is pasty or thick, such as this sugar juice, cannot move freely, and flow up from the bottom, so as to cause a continual renewal of the parts exposed to the heated surface. Some portion, therefore, remains too long in contact with the highly-heated metal, and gets burnt, and the consequence is that the juice which enters the first of these evaporates as a clear yellow liquid; when it is dipped or "skipped" out, as it is termed, of the "teach," it has assumed the appearance of very dark treacle. The ordinary constituents of cane juice are—Water, 81 per cent; sugar, about 18; organic bodies, like gum, 0·6; and inorganic, like salts, about 0·4. This is only a rough general analysis, which takes no notice of the presence of any inverted sugar, and so far, therefore, it is incorrect, inasmuch as cane juice always contains a small quantity of this altered sugar ready formed, amounting generally to about 0·5 or 0·6 per cent of the whole amount of sugar, that is, in sound, ripe canes; in those which are rotten, or half rotten, the proportion is much higher. After the liquid has been boiled in the first of these evaporating pans, it has been found that there is sometimes as much as 10 per cent of this altered sugar for every 100 parts of real sugar, while in the last, the "teach," where it has received its final concentration, and attained the highest temperature, and been subjected for the longest time to all these mischievous influences which I have mentioned, the proportion of this altered sugar has risen to 22 or nearly 23 per cent. The mischief of this is, not only that you have destroyed so much of the sugar, but the presence of this altered sugar renders it extremely difficult, even if it does not absolutely prevent, the recovery of another equal portion of still unaltered cane sugar in a marketable form. The liquid containing a considerable proportion of the altered sugar has the consistency of treacle, and it is not easily deprived of so much of its water by evaporation as to leave the unaltered sugar in a state of a hot saturated solution, capable of crystallising or cooling. Even if crystallisation is actually obtained, the crystals are formed in a thick, adhesive, semi-fluid mass, from which you cannot separate them; consequently the mischief of converting a portion of your cane sugar into this altered sugar is not confined to the simple loss of the quantity so converted, the actual loss being nearly double; for one part of this altered sugar appears to practically prevent the crystallisation of an equal weight of cane sugar.* This is one great source of loss, but previous to this there was another. I have said nothing at present about the yield of juice by this method of pressure between rollers; but it is a very poor one indeed. Average canes of good quality contain about 90 per cent of juice, there being only about 10 per cent of actual woody matter; yet it is considered a very good yield to get out 60 per cent. If, therefore, you only get 60 per cent out of 90, you have left in the residue half as much as you have won. That would not answer in most manufacturing operations, and it is a very poor yield as compared with what is obtained in working beet-root. Only two-thirds of the sugar is got out of the cane in the form of juice, and when that is obtained the manufacturer immediately proceeds to waste a great portion. At a moderate computation, an acre will grow 30 tons of sugar-cane, and in those you will have 90 per cent of juice, containing, say, 18 per cent of sugar; working this out, I find that the sugar produced from an acre is about 4·86, or nearly five tons. Then, taking the 60 per cent yield of juice, and allowing very moderately for loss, the sugar actually won is only equal to two and a half tons, so that the quantity of sugar sent into the market is about one-half of that which is taken off the ground. As the concentrated juice is "skipped" out from the teach, it is transferred to round, shallow coolers, and allowed to stand until it is of the right consistency, when it is put into hogsheads, the bottoms of which are pierced with a number of holes, loosely

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* This statement must not be taken as an expression of a fully-ascertained fact as regards the quantity.

stopped with some convenient material, such as the stalk of a plantain leaf, and there it is allowed to remain for a considerable time, in a warm temperature, over a grated floor, until, in fact, the crystals of sugar are formed, surrounded by a cool saturated solution of sugar, containing also many impurities, being what is called syrup. This syrup is allowed to drain away gradually, leaving behind a mass of soft brown sugar, which is known in the market as raw sugar. The quality of this product so obtained varies greatly on different estates, with the amount of skill applied in the manufacture, the quality of the cane, &c. Sometimes it is very bad indeed, as you may see by a sample on the table, and the colour varies with the quality. There is one sample of nearly pure sugar which is really raw cane sugar; but it was not made in the mode I have described, the manufacturer having exercised some little skill and judgment, and brought into use some of the more modern appliances which science has devised.

I will next describe an important method of getting the juice out of the cane, by which a much larger yield is obtained, whilst the juice itself is much purer, containing a smaller proportion of the organic salts, which are the bodies which most assist fermentation, which, as you know, produces a serious loss of sugar. The process is known by the name of diffusion, and it will, I dare say, suggest to you the means by which the juice is won. It is carried on upon a large scale at the Aska Sugar Works, near Madras, and Mr. Minchin, the able and energetic manager, assures me that it really leaves little or nothing to be desired. The yield of juice, instead of being only 60 per cent, amounts to over 85, leaving only 5 out of 90 per cent instead of 30, as in the old process. This is a very considerable gain at once; but, in addition, the juice is much purer than that got out by means of rollers; it is therefore more easily worked, and a larger quantity of sugar of finer quality is obtained. And when you recollect that every ton of sugar lost represents a loss of about £25 to the manufacturer, you will see that it is a matter of primary importance to get every cwt. possible. The principle of the method is this. The canes are cut up by suitable machinery into thin diagonal slices. These are filled into a cylindrical iron vessel, about 6 or 7 ft. high, and from 4 ft. to 4ft. 6 in. diameter, the size being merely a matter of convenience. Room is left for the addition of so much water as will keep the slices afloat, so that they are surrounded by water on all sides. The vessel is allowed to stand for fifteen or twenty minutes, while a second vessel of like capacity is filled with cane cuttings, but no water being added. By this time a considerable proportion of the sugar contained in the cells of the plant has passed out through the cell walls into the surrounding water by the process of diffusion, similar to that which I exhibited to you, the organic non-saccharine bodies, which are mostly colloids, remaining behind. But as you will, doubtless, have remarked, this process of diffusion must come to an end when the water surrounding the cells contains as much sugar as that in the inside, and, practically, the extreme limit is not quite reached. However, when the water in the first vessel has got considerably charged with sugar, it is passed into the second, which contains fresh cane cuttings filled with highly concentrated juice. Diffusion then begins in the second vessel, the sugar in the cane cells being undiluted passes out into the diluted liquid and increases the strength of the solution, and at the same time the first vessel has been filled up with fresh water, so that the sugar remaining in the cane cells in it may also diffuse out. The stronger solution in the second vessel is then passed on into a third diffuser, containing fresh cuttings, and sometimes into a fourth, which is about the limit to which the process can advantageously be carried; and from thence, being now sufficiently concentrated, it is drawn off and taken to the clarifiers, and thence to a vacuum pan, for I need hardly say that where such a scientific method of obtaining the juice is followed, they do not boil it in the open air. While this is going on, the second supply of water has been passed on to the second diffuser, and so on consecutively, until it is found that the water from the first vessel contains no more sugar, and when that vessel is disconnected from the series and emptied, the second becomes the first of the series, and so on in succession, a vessel of fresh cuttings being added at the end, when one is removed at the beginning. It is a somewhat complicated system to describe, but it is very simple in work, and is found to yield very good results.

In some of the colonies, both English and French, improved methods of manufacturing sugar from the cane are coming, though slowly, into use; and taking into consideration the weight of canes which can be grown to the acre, the richness and the purity of the juice of these canes, it seems hard to believe that the makers of sugar from the comparatively poor beet will be able to hold their own, when they no longer possess a monopoly of skill and science. These improved processes of manufacture I must leave undescribed, time only allowing me to sketch in outline one of the many methods in actual use.

I must now pass on to some chemical facts which will concern us in the manufacture of sugar from beet-root, which is a more complicated process than that I have described as applied to the juice of cane. I have treated of the cane sugar manufacture in this order simply to show you how very small an amount of chemical knowledge is necessarily brought to bear in the manufacture of sugar from cane. All this, and much more, is required in the case of the beet-root sugar manufacture.

In the first place I must show you that lime, which is an agent very largely employed in the manufacture of sugar from beet-root, is much more soluble in solutions of sugar than in water. I cannot very well exhibit this to you in quantitative fashion, for naturally quantitative experiments consume a good deal of time, but I can show you that lime is taken up very largely by a solution of sugar. In a solution of sugar, to which I will add some slaked lime, after filtering it, we shall find that a considerable portion of the lime has passed into solution. Lime is an alkaline body, *i.e.*, possessed of powers like those of potash or soda, having the power of neutralising acids very effectually indeed; it has also the property, when in solution, of preventing fermentation. Thus a solution of caustic lime will prevent a solution of sugar from fermenting. Here is the filtered solution of sugar into which I put the lime, and I shall be able to show you that it is alkaline. Here is a slip of paper impregnated with tincture of turmeric. It is, as you see, of a yellow colour, but in the presence of alkalies it becomes of a reddish brown. You see it turns brown on being dipped into our solution. Here, again, is a slip of paper reddened with litmus, which has the property of turning blue on the application of an alkali, and this also answers to the test. I do this that you may see how readily the presence of lime can be detected, because I want to show you by-and-by how completely we can remove lime from a solution of sugar after it has been added. In the manufacture of beet-root sugar, lime has to be added at one stage in considerable excess, and it has to be removed afterwards with tolerable completeness, and you thus see how we can detect its presence.

I must now show you another property of lime, viz., that of very readily absorbing carbonic acid gas. I have here a ready-made solution of lime in sugar, which I take because it happens to be a convenient form in which to employ the lime. I will now prepare a little carbonic acid gas, with which I will fill a long glass tube; then, pouring some of the solution of lime in sugar into this glass basin, I introduce the mouth of the tube into it, so as to allow a small portion of the solution to enter, and on closing the mouth of the tube with my finger and agitating it, you will find that the lime present absorbs the whole of the carbonic acid gas. The liquid, you see has turned quite milky, owing to the fact that the carbonic acid combining with the lime has converted it into carbonate, and the carbonate of lime is not soluble in sugar. You see at once, therefore, that there is a method of removing an excess of lime from a solution of sugar; and this process is all the better for this reason, that carbonic acid is so very weak an acid that it is not capable of inverting the sugar itself. So that, when you have a solution of sugar containing lime, you can remove the lime without fear of injuring the sugar, by passing carbonic acid gas into it until no more is absorbed. On opening the mouth of the tube under water, I find that I did not pass in quite enough sugar-lime to absorb the whole of the carbonic acid acid gas, but there is only a very small quantity left.

A reaction which illustrates the same thing in another way, though, perhaps, not quite so clearly, is by passing the gas into a solution of sugar-lime, which I will now do, putting some of the sugar-lime into a glass vessel, into which I insert the delivery-tube of the apparatus for evolving carbonic acid gas. You will observe that precipitation will not take place for a short time, and for a reason which is not thoroughly explained at present, but the fact, I believe, is that an intermediate compound is formed between lime and carbonate of lime. Carbonic acid can be passed into a solution of sugar containing lime, until nearly a third of the lime is really converted into carbonate, without any precipitation taking place, and then, almost of a sudden, the solution will become thick and opaque, and the lime will be deposited as insoluble carbonate.

I will now briefly describe the properties of animal charcoal, which is a body of considerable importance in sugar-making. Animal charcoal is prepared from bones, and bones, as you know, consist mainly of two parts, one being an animal part, a sort of gelatinous material, which is stiffened by the other, an earthy body, diffused throughout the mass. I have here a mutton bone, out of which I have taken the earthy material, and you observe that although it keeps its form, it is quite flexible and elastic, that is the animal part. When the animal part is destroyed, which can be done by exposing the bone to a high temperature in contact with the air, the animal matter is entirely burnt away, and there is left behind an extremely brittle material, the earthy phosphate of lime. The earthy material of bone consists essentially of phosphate of lime, which is left behind when the animal portion is entirely destroyed by oxidation at a high temperature. But instead of carrying the burning process to this stage, if we may simply expose a fresh bone to a high temperature without allowing the access of air, as is done by ordinary charcoal burners, the volatile constituents of the animal body will go off in the form of various gases, and a considerable portion of carbon will remain behind in the solid form. But of course the earthy matter also remains behind, and consequently we shall get such a mass as I have here—a bone which has been heated to redness for two hours, but without the access of air; the volatile constituents, the oxygen, the hydrogen, the nitrogen, and some of the carbon, have gone off, leaving behind a great part of the carbon dispersed over the surface of the particles of phosphate of lime. We have, therefore, in animal charcoal a quantity of very finely divided carbon spread over the surface of the phosphate of lime. Bones which have been treated in this way, and subsequently crushed into coarse grain, such as I have here, are largely employed by the manufacturers and refiners of sugar under the name of animal charcoal. I have here some of the animal charcoal from which the phosphate of lime has been removed by the action of acid; it is an exceedingly light powder, so much so that the bottle, on giving it a shake, appears full of it, and on removing the stopper it escapes almost like smoke. The action of the animal charcoal resides entirely in this carbon, the phosphate of lime with which it is usually conjoined having no other use than to render the material firm, hard, and heavier than the sugar solution, and consequently usable on a large scale.

The action of this animal charcoal, to which I wish particularly to direct your attention this evening, is the power which it possesses of absorbing from an aqueous solution certain bodies which are exceedingly prejudicial to the sugar maker, viz., the organic bodies, the colloids which get into the juice more or less in the process of manufacture. Again, as a sample of these colloid bodies, I will take dextrine, not because it is better than others, but because I can more readily prove to you its presence or absence. In this flask there is a solution of dextrine, which I will prove, as before, by its action in the presence of iodine. I will now pour it into this tube, which contains a quantity of finely granulated animal charcoal, and, by turning a cock at the bottom, will allow it to run through slowly. I cannot on the present occasion allow sufficient time for the action to be complete; but if it stood for some hours the absorption of the dextrine would be very complete; as it is, it will probably be only partial; still, on treating the solution which has run through with iodine, you will see that there is a very perceptible difference in the quantity remaining in solution, as evidenced by the intensity of the colour produced.

In my next lecture I shall treat of the manufacture of sugar from beet-root by one of the most approved methods. I see that I shall not be able to enter into the question of the different modes of extracting juice from the beet, and their relative advantages and disadvantages, but must confine myself to the process most largely in use, and from that pass on to the method of purification most usually employed. I will now add a little iodine to the solution which has run through the animal charcoal, and you see it is scarcely coloured, showing that the dextrine has been in great measure absorbed.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 18th, 1872.

Dr. Frankland, President, in the Chair.

As unfortunately both the Secretaries of the Society were absent through illness, Dr. Odling kindly acted in their place.

Messrs. Martineau, Page, Munroe, and Child were formally admitted members of the Society, and after the donations had been announced, the names of the following gentlemen were read for the first time:—Lüdwig Mond, Edward Packard, jun., John Ruffle, Frederick John Bassett, Edward Handfield Morton, and Ross Scott, M.A.

For the third time—Messrs. Julian Louis Vanderstraaten, John Millar Thompson, Charles W. Vincent, Robert Barton, David Watson, William Thompson, William Forster, Henry James Helm, Thomas W. Fletcher, George Thomas Glover, and Thomas Eltoft, who were then ballotted for and declared duly elected.

Dr. **Odling** exhibited several specimens of rare chemical substances which had been lent to him by Dr. Richter and Dr. Theodor Schuchardt, amongst which were two samples of metallic indium, the larger weighing 200 grms., also a specimen of the zinc blende of Freiburg in which this element was first discovered. After briefly recapitulating the method of extracting it, he remarked that it was very soft, even more so than lead; its specific gravity, however, was much less, being only 7·3 or 7·4. It was, moreover, the most fusible of all the metals that were capable of being freely exposed to the atmosphere without undergoing any great change, its melting-point being 176° and therefore considerably lower than that of tin or cadmium. When freshly cut or scraped it was white or faintly yellowish in colour, but quickly acquired a bluish tinge from incipient oxidation. The metal itself is not very volatile, but the chloride volatilises at a low red heat. It had been known for some time that 37 or 38 parts of indium combined with 35·5 chlorine, but from comparatively recent determinations of its specific heat by Bunsen and others its equivalent was found to be 113·5, so that the chloride at present known must be the terchloride. Specimens of metallic beryllium closely resembling boron in appearance, beautifully crystallised beryllium sulphate, metallic zirconium in the graphitic state obtained from the alloy of aluminium and zirconium, also of vanadium, vanadic acid, lithium, rubidium alum, and metallic rubidium were exhibited.

The PRESIDENT said the thanks of the Society were due to Dr. Odling for giving them the opportunity of examining these specimens of rare substances; he himself, and, in all probability, the greater majority of the Fellows present, had never before seen such fine specimens of these rare metals and their compounds.

Mr. DAVID HOWARD then read a paper on "*Quinicine and Cinchonicine and their Salts.*" The author stated that further investigation had convinced him that the alkaloid from cinchona bark, which he had briefly described in the *Journal of the Chemical Society* in the early part of 1871, was identical with the quinicine of Pasteur. He had carefully examined and compared the quinicine and its salts, prepared both from quinine and from quinidine, and found them to be identical. It is not merely the action of heat which causes the transformation of these alkaloids into quinicine, for their salts were but slightly affected when heated with water in sealed tubes even to a considerably higher temperature than would effect their complete conversion under favourable circumstances. Most of the salts of quinicine crystallise with difficulty: the chloroplatinate, $C_{20}H_{24}N_2O_2,2HCl,PtCl_4$, the oxalate, $2(C_{20}H_{24}N_2O_2)C_2H_2O_4+9H_2O$, and the acid tartrate, however, are exceptions, being readily obtained in a state of purity. Cinchonicine and its salts, whether prepared from cinchonine or cinchonidine, are identical, and closely resemble those of quinicine in their properties. The alkaloid is soluble in ether, and its salts are generally somewhat more soluble than the corresponding quinicine compounds. The chloroplatinate, $C_{20}H_{24}N_2O,2HCl,PtCl_4$, the oxalate, $2(C_2H_{24}N_2O)C_2H_2O_4+7H_2O$, and the acid tartrate all crystallise well. The action on polarised light exerted by quinicine from whatever source it is obtained is 39° to the right for the yellow ray, the base being dissolved in spirit; for cinchonicine it is 48°. The author concluded by discussing the question of the identity of the resinoid quinoidin with these alkaloids.

The PRESIDENT said that he had listened with great interest to Mr. Howard's communication on these isomeric alkaloids. Their properties and those of their compounds which he had so carefully examined would form points of comparison for future workers on the cinchona alkaloids of the quinine and cinchonine series, and it would be of interest to the members if the author could give them any particulars about the nature of this isomerism.

Mr. HOWARD having answered that he was at present unprepared to offer an opinion on this subject, Dr. WRIGHT said that some experiments on which he was now engaged, although in a different series of the alkaloids, might, perhaps, tend to throw some light on this question. By the action of phosphoric acid on codeia, two bodies having the same percentage composition as codeia are formed. These differ from codeia especially in the following property: codeia is precipitated from its solution by carbonate of soda only after some time, whilst both the new compounds are immediately precipitated; the first, however, is amorphous and soluble in ether, whilst the second is insoluble. By the action of hydrochloric acid on codeia he had obtained a compound, $C_{36}H_{41}ClN_2O_5$, showing that the real formula for codeia was $C_{36}H_{42}N_2O_6$, being double that usually assigned to it. In the same way he had found that the first of the new compounds had double the formula of codeia, containing C_{72}, and the second double that again, so that the new substances were dicodeia and tetracodeia respectively. They were therefore not isomeric but polymeric with codeia. Perhaps the relation in the cinchona series might also be that of polymerism and not isomerism.

Mr. HOWARD observed that from the very different action which quinicine had upon polarised light when compared with quinine and quinidine, he should be inclined to believe that the change which had taken place was something more than a simple polymerisation, particularly as the saturating power was the same. What he considered especially interesting was that the action upon polarised light of the new isomer quinicine from either source was absolutely identical, notwithstanding that the quinine and quinidine from which it was derived possessed in one case a powerful lœvo-rotary action, and in the other a dextro-rotary, and the same might be said of cinchonicine. It would also appear that the quinicine is present in the original bark, and is probably the first formed alkaloid, being subsequently converted into quinine and quinidine.

Dr. ODLING then announced that besides the Faraday lecture by Professor Canizzaro arrangements had been made for the delivery of three other lectures during the course of the session, namely, "On Hydrocarbons," by Dr. Schorlemmer, F.R.S.; "On the Manufacture of Chlorine," by Mr. Deacon; and "On the Manufacture of Iron and Steel," by Mr. Riley.

The meeting was then adjourned until Thursday, February 1st, when there will be a paper "On the Relations between the Atomic Theory and the Condensed Symbolic Expressions of Chemical Facts and Changes.—Dissected Formulæ," by Dr. Wright.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 9th, 1872.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

"*On the Influence of Gas and Water Pipes in Determining the Direction of a Discharge of Lightning.*" By HENRY WILDE, Esq.

Although the invention of the lightning conductor is one of the noblest applications of science to the wants of man, and its utility has been established in all parts of the world by the experience of more than a century, yet, a sufficient number of instances are recorded of damage done by lightning to buildings armed with conductors to produce, in the minds of some, an impression that the protective influence of lightning conductors is of but questionable value.

The destruction, by fire, of the beautiful church at Crumpsall during a thunderstorm on the morning of the 4th inst., has induced me to bring before the Society, with a view to their being known as widely as possible, some facts connected with the electric discharge which have guided me for some years in the recommendation of means by which disasters of this kind may be averted.

For the proper consideration of this subject it is necessary to make a distinction between the mechanical damage, which is the direct effect of the lightning stroke, and the damage caused indirectly by the firing of inflammable materials which happen to be in the line of discharge.

Instances of mechanical injury to buildings not provided with conductors are still sufficiently numerous to illustrate the teriffic force of the lightning stroke, and at the same time the ignorance and indifference which prevail in some quarters with respect to the means of averting such disasters; for wherever lofty buildings are furnished with conductors from the summit to the base, and thence into the earth, damage of the mechanical kind is now happily unknown.

Even in those cases, where lightning conductors have not extended continuously through the whole height of a building, or where the lower extremity of the conductor has, from any cause, terminated abruptly at the base of the building, the severity of the stroke has been greatly mitigated, the damage being limited, in many cases, to the loosening of a few stones or bricks.

The ever extending introduction of gas and water pipes into the interior of buildings armed with lightning conductors has, however, greatly altered the character of the protection which they formerly afforded, and the conviction has been long forced upon me that, while buildings so armed are effectually protected from injury of the mechanical kind, they are more subject to damage by fire.

The proximity of lightning conductors to gas and water mains, as an element of danger, has not yet, so far as I know, engaged the attention of electricians, and it was first brought under my notice at Oldham in 1861, by witnessing the effects of a lightning discharge from the end of a length of iron wire rope, which had been fixed near to the top of a tall factory chimney, for the purpose of supporting a long length of telegraph wire. The chimney was provided with a copper lightning conductor terminating in the ground in the usual manner. In close proximity to the conductor, and parellel with it, the wire rope descended, from near the top of the chimney, for a distance of 100 feet, and was finally secured to an iron bolt inserted in the chimney about 10 feet from the ground. During a thunderstorm which occurred soon after the telegraph wire was fixed, the lightning descended the wire rope, and instead of discharging itself upon the neighbouring lightning conductor, darted through the air for a distance of 16 feet to a gas meter in the cellar of an adjoining cotton warehouse, where it fused the lead pipe connections and ignited the gas. That the discharge had really passed between the end of the wire rope and the lead pipe connections was abundantly evident from the marks made on the chimney by the fusion and volatilisation of the end of the wire rope, and by the fusion of the lead pipe. As the accident occurred in the daytime, the fire was soon detected and promptly extinguished.

Another and equally instructive instance of the inductive influence of gas pipes in determining the direction of the lightning discharge occurred in the summer of 1863 at St. Paul's Church, Kersal Moor, during divine service. To the outside of the spire and tower of this church a copper lightning conductor was fixed, the lower extremity of which was extended under the soil for a distance of about 20 feet. The lightning descended this conductor, but instead of passing into the earth by the path provided for it, struck through the side of the tower to a small gas pipe fixed to the inner wall. The point at which the lightning left the conductor was about 5 feet above the level of the ground, and the thickness of the wall pierced was about 4 feet; but beyond the fracture of one of the outer stones of the wall, and the shattering of the plaster near the gas pipe, the building sustained no injury.

That the direction of the electric discharge had, in this case, been determined by the gas pipes which passed under the floor of the church was evident from the fact that the watches of several members of the congregation who were seated in the vicinity of the gas mains were so strongly magnetised as to be rendered unserviceable.

The church at Crumpsall is about a mile distant from that at Kersal Moor, and the ignition of gas by lightning, which undoubtedly caused its destruction, is not so distinctly traceable as it is in other cases which have come under my observation, because the evidences of the passage of the electric discharge have been obliterated by the fire. From information, however, communicated to me by the clerk in charge of the building, as to the arrangement of the gas pipes, the most probable course of the electric discharge was ultimately found.

The church is provided with a copper lightning conductor, which descends outside the spire and tower as far as the level of the roof. The conductor then enters a large iron down-spout, and from thence is carried into the same drain as that in which the spout discharges itself. Immediately under the roof of the nave, and against the wall, a line of iron gas pipe extended parellel with the horizontal lead gutter which conveyed the water from the roof to the iron spout in which the conductor was enclosed. This line of gas-piping, though not in use for some time previous to the fire, was in contact with the pipes connected with the meter in the vestry, where the fire originated, and was not more than three feet distant from the lead gutter on the roof. As no indications of the electric discharge having taken place through the masonry were found, as in the case of the church at Kersal Moor, it seems highly probable that the lightning left the conductor at the point where the latter entered the iron spout, and by traversing the space between the leaden gutter and the line of gas-piping in the roof, found a more easy path to the earth by the gas mains than was provided for it in the drain.

In my experiments on the electrical condition of the terrestrial globe* I have already directed attention to the powerful influence which lines of metal, extended in contact with moist ground, exercise in promoting the discharge of electric currents of comparatively low tension into the earth's substance, and also that the amount of the discharge from an electro-motor into the earth increases conjointly with the tension of the current and the length of the conductor extended in contact with the earth. It is not, therefore, surprising that atmospheric electricity, of a tension sufficient to strike through a stratum of air several hundred yards thick should find an easier path to the earth by leaping from a lightning conductor through a few feet of air or stone to a great system of gas and water mains, extending in large towns for miles, than by the short line of metal extended in the ground which forms the usual termination of a lightning conductor.

It deserves to be noticed that in the cases of lightning discharge which I have cited, the lightning conductors acted efficiently in protecting the buildings from damage of a mechanical nature—the trifling injury to the church tower at Kersal Moor being directly attributable to the presence of the gas pipe in proximity to the conductor. Nor would there have been any danger from fire by the ignition of the gas if all the pipes used in the interior of the buildings had been made of iron or brass instead of lead; for all the cases of the ignition of gas by lightning, which have come under my observation, have been brought about by the fusion of lead pipes in the line of discharge. The substitution of brass and iron, wherever lead is used in the construction of gas apparatus, would, however, be attended with great inconvenience and expense, and moreover, would not avert other dangers incident to the disruptive discharge from the conductor to the gas and water pipes within a building. I have therefore recommended that in all cases where lightning conductors are attached to buildings, fitted up with gas and water pipes, the lower extremity of the lightning conductor should be bound in good metallic contact with one or other of such pipes outside the building. By attending to this precaution the disruptive discharge between the lightning conductor and the gas and water pipes is prevented, and the fusible metal pipes in the interior of the building are placed out of the influence of the lightning discharge.

Objections have been raised by some corporations to the establishment of metallic connection between lightning conductors and gas mains, on the ground that damage might arise from ignition and explosion. These objections are most irrational, as gas will not ignite and

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* *Philosophical Magazine*, August, 1868.

explode unless mixed with atmospheric air, and the passage of lightning along continuous metallic conductors will not ignite gas even when mixed with air. Moreover, in every case of the ignition of gas by lightning, the discharge is actually transmitted along the mains, such objections notwithstanding. A grave responsibility therefore rests upon those, who, after introducing a source of danger into a building, raise obstacles to the adoption of measures for averting this danger.

Dr. Joule remarked that, at twenty minutes past four, when the hail storm was at its height, the atmosphere was illuminated by a bright red light. This phenomenon disappeared when the fall of hail ceased.

NOTICES OF BOOKS.

Technical Arithmetic and Mensuration. By Charles W. Merrifield, F.R.S., Principal of the Royal School of Naval Architecture and Marine Engineering, &c. London: Longmans and Co. 1872. 308 pp., 8vo.

This is one of the deservedly popular series of text-books of science published by Messrs. Longmans. Mr. Merrifield deals with his subject in a manner that cannot fail to be clear to the student. The finding of the cube root is much simplified, and a rule is given which one can easily remember. Another feature is the introduction of a chapter on mechanical work. No person who thoroughly studies that chapter is at all likely to entertain the fallacy of supposing that a machine can produce perpetual motion. The obtaining of a specific gravity, or rather the arithmetical work it involves, is well treated. The book concludes with an admirable chapter on the Laws of Guldinus applicable to lathe-work; and there is appended a series of examination papers actually set at various public examinations. It is the best arithmetic we have seen.

Principles of Chemical Philosophy. By Josiah P. Cooke, jun., Erving Professor of Chemistry and Mineralogy in Harvard College. Second Edition. Boston: John Allyn.

Mr. Cooke presents his work with the prefactory recommendation that the elementary facts of chemistry should be observed by the student in the phenomena in which they appear, and not learnt *memoriter* from the text-book, a method that he, with us, deprecates as leading to a superficial knowledge of the science. But the book is worthy of study by the scientific inquirer as well as by the student; for the author advances some very carefully considered theories. Professor Cooke's position renders the book also valuable to the teacher, because the latter can place perfect faith in the suitability of the questions proposed for examination. We must commend the arrangement: theory is not too strictly adhered to, but is made to serve its true purpose, to become a mnemonical chain by which facts are linked into one coherent whole easily grasped by the mind. The clear exposition of the relation of the atoms to heat, light, and electricity especially deserves notice. It is a text-book of which even Harvard may justly be proud, and we cordially recommend it to our English students.

MISCELLANEOUS.

To Grow Large Crystals.—In order to grow large crystals of such substances as sugar, borax, alum, and the like, Professor Schulze recommends the use of gelatinous solutions, such as pectin and gelatin. The crystals separate, suspended in the mass, and go on growing uniformly on all sides. In this way, irregularities and distortions are avoided. The determination of the amount of gelatinous matter to be added must be the result of experiment. The chief advantage appears to be to make the liquid of such a specific gravity as will hold the crystals in suspension.—*Scientific American.*

Extemporaneous Ink.—The following recipe will give black ink of good colour and permanency:—Take of tannic and gallic acids each 20 grains, dissolve in 2 fluid ounces of water; take also of crystallised sulphate of iron and of the dried sulphate (*sulphas ferri exsiccatum*), of each 15 grains, and dissolve these separately in a similar quantity of water (best distilled); mix the two solutions, and add of mucilage (*mucilago gummi arabici*) 2½ fluid drachms, of oil of cloves 2 drops. Although this ink is by no means cheap, it is preferable to every other, and is a very fine black and quite permanent.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, December 26, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Very Perceptible Tension of Mercurial Vapours at a Low Temperature.—V. Regnault.—The celebrated *savant*, referring to M. Merget's essay on the volatilisation of mercury, calls the attention of the meeting to his discoveries on this subject as far back as 1838 and 1844 (*Annales de Physique*, 3rd series, vol. xi., 1844), and to what has been published by him in the *Mémoires de l'Academie*, vol. xxxi., p. 506. It appears that even at −15° mercury was found by the author to be volatilised continuously.

Electrical Conductibility of Liquids when no Electrolysis takes place.—P. A. Favre.—Notwithstanding the great intrinsic merits of this exhaustive memoir, it is not suited for any useful abstraction, an observation also applicable to the following essay:—

Researches on the Condition of Metallic Salts while in Solution.—Dr. Berthelot.

Description of an Apparatus Suited for the Purpose o Estimating the Temperature at which Detonating Compounds become Changed and Explode.—L. Leygue and M. Champion.—From a tabulated form appended to this paper, and exhibiting some of the results of experiments made by the authors, we learn that fulminate of mercury becomes ignited and detonates at 200°; gun-cotton, at 220°; sporting powder, at 288°; gunpowder used for heavy ordnance, at 295°; the picrates of lead, iron, and mercury, all at 296°; nitro-glycerine, at from 256° to 257°; sulphur ignites in air at 246°; the powder (fulminate) contained in the caps of the Chassepot rifles, at 191°.

Analysis of the Amblygonite (Montebrasite) from Montebras.—F. Pisani.—After referring to the paper of Moissenet on this subject (see Chemical News, vol. xxiv., p. 97), the author states that, having observed the perfect mineralogical resemblance of Montebrasite with amblygonite, he has made an analysis of Montebrasite, the results of which, in 100 parts, are—Fluorine, 8·20; phosphoric acid, 46·15; alumina, 36·32; lithia, 8·10; soda, 2·58; oxide of manganese, 0·40; loss by ignition, 1·10; total, 102·85. Considering that these figures closely agree with those which Dr. Rammelsberg found for the amblygonite from Arnsdorff, Montebrasite cannot be viewed as a new mineral but as a real amblygonite.

Modification which Nitrous Acid Undergoes when in Contact with Arable Soil.—M. Chabrier.

Zeitschrift für Chemie von Beilstein, No. 14, 1871.

The following original papers and memoirs are contained in this number:—

Reciprocal Interchange of some Metalloids.—G. Gustavson.—After briefly referring to a former paper on this subject published by him some years ago, the author states that PCl_5 and B_2O_3 act upon each other in such a manner that all the chlorine of the chloride of phosphorus becomes chloride of boron. B_2O_3 and $POCl_3$ act in a similar manner—$B_2O_3+2POCl_3=PBO_4+PBOCl_6$; the mixture of B_2O_3 and $POCl_3$ is heated, for from eight to ten hours, to 150° in a sealed tube at the upper part of this tube crystals of $PBOCl_6$ are sublimed, while at the bottom a whitish mass (PBO_4) is found; this latter body is, however, only a mixture, it appears, of—

$$2PBO_4 = P_2O_5 + B_2O_3,$$

but, after having been ignited, it becomes insoluble in water, and soluble in boiling alkaline solutions, but then salts of boric and phosphoric acids are formed. The compound $PBOCl_6$ can be dissociated by sublimation.

Amido-Camphoric Acid.—F. Wreden.—Amido-camphoric-acid-anhydride, $C_{10}H_{13}(NH_2)O_3$, is formed when bromo-camphoric-acid-anhydride, $C_{10}H_{13}B_2O_3$, is heated to 150° along with aqueous NH_3. The amido-camphoric-acid-anhydride is a crystalline substance, fuses at 208°, begins, however, to sublime at 150°, is readily soluble in boiling alcohol, but only slightly soluble in cold alcohol, ether, and boiling water; by being boiled with weak potassa solution (10 per cent dry alkali), this substance is converted into amido-camphoric acid, while boiling with strong alkaline solutions converts it into oxy-anhydride of camphoric acid, $C_{10}H_{13}(HO)O_3$. Amido-camphoric acid—

$$C_{10}H_{15}(NH_2)O_4 + H_2O,$$

is also a crystalline body, difficultly soluble in ether and boiling water; it fuses at 160°, forming anhydride; it loses at 85° its water of crystallisation, and at about 100° it is converted into the anhydric acid; the author briefly describes some of the salts of this acid.

Basicity of Camphoric and Meso-Camphoric Acids.—F. Wreden.—After referring at some length to the opinions and researches of Weyl, Berthelot, and Gille, on the constitution and behaviour of camphoric acid with reducing agents, the author states that camphoric acid really appears to be a dicarbonic acid, which gives up readily a molecule of H_2O. The author next treats on a meso-camphoric acid, $C_{10}H_{16}O_4$, obtained by treating camphoric acid with HI (sp. gr. = 1·6) at a temperature of from 150° to 160° for two days, the mixture being heated in a sealed glass tube. The acid thus formed fuses at 113°, becomes oily when treated with alcohol and ether, and crystallises, without forming an anhydride (as ordinary camphoric acid does under the same condition), from its solution in strong sulphuric acid.

Action of β-Toluol-Sulpho-Acid-Chloride upon Acid-Amides.—Anna Wolkow.—This paper treats on the action of para-toluol-sulpho-acid-chloride upon benzamide, upon cinnamic-acid-amide, and upon acetamide. In the first instance, the result is the formation of benzo-nitrile, the reaction taking place according to the following formula:—

$$C_7H_7SO_2Cl + NH_2(C_7H_5O) = C_7H_7SO_3H + C_7H_5N + HCl.$$

In the second instance, cinnamic-acid-nitrile, hydrochloric acid, and β-toluol-sulpho-acid are formed. The action upon acetamide is quite analogous, but, instead of aceto-nitrile, a compound of that body and hydrochloric acid is formed.

New Amido-Acids.—Anna Wolkow.—This paper contains an account of researches made on benzoyl-para-nitro-toluol-sulpho-amide, $N(C_7H_6[NO_2]SO_2)(C_7H_5O)H$, a crystalline body, soluble in water; it fuses at 130°, and forms with several bases well-defined salts. Further, on benzoyl-para-naphthalin-sulpho-amide—

$$N(C_{10}H_7SO_2)(C_7H_5O)H,$$

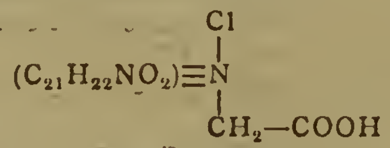
a crystalline body, insoluble in water, very difficultly soluble in alcohol and ether, soluble in acetic acid; it fuses at 194°, and forms with bases well-defined salts.

Fluid of the Cimbex Larvæ.—Dr. A. J. van Rossum.—The author communicates in this paper the results of his researches on a peculiar green-coloured fluid which the larvæ of the *Cimbex variabilis (Blattwespe)*, saw-fly, eject on being touched. This fluid, devoid of taste and smell, exhibits an alkaline reaction, and was found, upon thorough examination, to consist of a concentrated alkaline protein fluid, which has a great resemblance to albumen; there was only a trace of ash, and, as regards the green colour, it is very probably due to chlorophyll.

New Base from Strychnia.—Dr. P. Römer.—After first referring to the strychnin-oxethyl compounds discovered by Messel (*Ann. d. Chem. u. Pharm.*, clvii., part 1), the author states that he has studied the action of mono-chlor-acetic acid upon strychnia, both bodies being heated to 180° for several hours; after purifying, the author obtained a crystalline compound, which was found to combine with platinic chloride, $(C_{23}H_{24}N_2O_4.HCl)2PtCl_4$. This new base is formed from strychnia according to the following formulæ:—

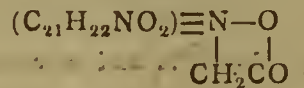
$$C_{21}H_{22}O_2O_2 : C_2H_3ClO_2 = C_{23}H_{25}N_2O_4Cl$$
$$C_{23}H_{25}N_2O_4Cl : NH_3 = NH_4Cl, C_{23}H_{24}N_2O_4$$

When the formula of strychnia is taken as $(C_{21}H_{22}NO_2)\equiv N$, the chlorine combination of the new base is—



$$\begin{array}{l} \phantom{(C_{21}H_{22}NO_2)\equiv{}}Cl \\ \phantom{(C_{21}H_{22}NO_2)\equiv{}}| \\ (C_{21}H_{22}NO_2)\equiv N \\ \phantom{(C_{21}H_{22}NO_2)\equiv{}}| \\ \phantom{(C_{21}H_{22}NO_2)\equiv{}}CH_2—COOH \end{array}$$

and the new base—



$$\begin{array}{l} (C_{21}H_{22}NO_2)\equiv N—O \\ \phantom{(C_{21}H_{22}NO_2)\equiv{}}|\quad\ | \\ \phantom{(C_{21}H_{22}NO_2)\equiv{}}CH_2CO \end{array}$$

Annalen der Chemie und Pharmacie, January, 1872.

The December number of this periodical has not come to hand yet; the present number contains the following original papers and essays:—

Contribution to our Knowledge of the Threefold Substituted Benzols.—M. Ascher.—This very lengthy and exhaustive essay is divided into the following sections:—Sulpho-terephthalic acid; bioxybenzoic acid; diazo derivative of amido-toluol-sulpho adid; salicylic acid; 2-4-bioxybenzoic acid. This essay is elucidated by a series of complicated formulæ and diagrams illustrating the constitutional formulæ of the bodies treated of.

Formation of the Fatty Alcohols from their Initial Constituent Molecules (Anfangsgliedern).—E. Linnemann and V. V. Zotta.—Ninth instalment of this exhaustive monograph. This portion is divided into the following chapters:—Reduction of formic acid to form aldehyde and methylic alcohol; synthesis of normal propylic alcohol; reduction of propionic-acid-anhydride; reduction of propionic acid to propyl-aldehyde and propylic alcohol; the pure normal propyl compounds; behaviour of normal iodide of propyl; mono-bromated normal bromide of propyl; conversion of normal propylic alcohol into isopropylic alcohol; conversion of normal nitrite of propylamine into isopropylic alcohol; conversion of propylen-bromide or propylen-chloride into aceton or into isopropyl derivatives; action of nascent hydrogen upon propylen-bromide; action of hydriodic acid upon propylen-bromide; behaviour of propylen-bromide with water; behaviour of propylen-chloride with nascent hydrogen; behaviour of propylen-chloride with hydriodic acid; behaviour of propylen-chloride with water; comparative experiments made with methyl-brom-acetol and methyl-chlor-acetol; re-conversion of normal propylic alcohol from isopropylic alcohol.

Constitution of Æsculine.—H. Schiff.—The contents of this very exhaustive and highly valuable scientific memoir are not well suited for any useful abstraction by reason of the large number of complex formulæ it contains.

New Series of Aromatic Hydrocarbons.—T. Zincke.—Second paper on this subject. Benzyl-toluol is a colourless agreeably-smelling fluid, readily soluble in alcohol, ether, chloroform, and acetic acid; it is not solidified at −30°; sp. gr. of this fluid at 17·5° = 0·995; the boiling-point is about 279°; simplest formula, $C_{14}H_{14}$; structural formula, $C_6H_5—CH_2—C_6H_4—CH_3$. Benzoyl-benzoic acid—

$$C_{14}H_{10}O_3,$$

is the product of oxidation of benzyl-toluol; it is a solid crystalline substance, readily soluble in ether, alcohol, and glacial acetic acid; it fuses at 194°, and sublimes at a higher temperature. Benz-hydryl-benzoic acid, $C_{14}H_{12}O_3$, is somewhat soluble in hot water, readily so in alcohol and ether; it fuses at 164°, and becomes decomposed when heated to above 200°. Benzyl-benzoic acid, $C_{14}H_{12}O_2$, is a solid body, difficultly soluble in water, readily so in alcohol, ether, and chloroform; it fuses at 155°, and readily forms, like the foregoing acids, salts with baryta, lime, and oxide of silver. Methyl-benzophenon, $C_{14}H_{12}O$, a colourless oily fluid heavier than water, boils at between 307° and 312°, does not become congealed at a low temperature; treated with chromic acid, it yields benzoyl-benzoic acid, and with nitric acid it forms nitro products.

Continuation of Researches on Abietinic Acid.—Dr. R. Maly.

Journal für Praktische Chemie, No. 19, 1871.

This number contains the following original papers and memoirs:—

Decomposition of Albumen by Permanganate of Potassa.—H. Tappeiner.—The main gist of this paper is a refutation of the correctness of Béchamp's experiments (*Comptes Rendus*, lxx., 866) on the production of urea from albumen under the influence of the permanganate of potassa.

Decomposition of the Soluble Sulphurets by Water.—Dr. H. Kolbe.—The eminent *savant* first refers at length to the extensive thermo-chemical researches of Thomsen, and then describes a series of researches made with the view of elucidating, under varying conditions, the behaviour of the soluble sulphurets with water. The chief result of the author's researches is that when the soluble sulphurets become dissolved in water they undergo a partial decomposition, due to the fact that the metals of these sulphurets have an equally strong affinity for the oxygen of the water as for the sulphur, and, as a consequence thereof, these sulphurets (as mono-sulphurets) undergo a partial decomposition into sulphydrate of the metal and hydrated oxide of the metal when only a small quantity of water is present, but with a large quantity of water this decomposition will proceed further.

Reducing Action of the Hydrogen Absorbed by Palladium.—Dr. H. Kolbe.—The contents of this paper record a few experiments, from which it appears that the hydrogen absorbed by palladium has the property of converting nitro-benzol into aniline when the vapours of the former are passed along with hydrogen gas over spongy palladium; chlor-benzoyl is converted, under similar conditions, into benzoic-acid-aldehyde and benzyl-alcohol; with spongy platinum this does not occur.

Acetylen and Allylen.—E. Carstanjen.—Notwithstanding the intrinsic value of this exhaustive memoir, its contents are not suited for useful abstraction.

Les Mondes, January 11, 1872.

Effect of Severe Cold upon Cast-Iron.—H. Cock.—The author relates that the cast-iron framework of a 12-horse horizontal high-pressure steam-engine, employed at the printing-works of MM. Renou and Maulde (Paris), after having been exposed for some hours to a temperature of −15° during the night of December 8 to 9 last, suddenly snapped to pieces in three different places when the engine-driver attempted to start the engine very cautiously and at slow speed on the morning of December 9 last.

Description of a Very-Large-Sized Electrical Induction Apparatus.—Dr. Wahl.—Illustrated by several woodcuts.

Bibliography.—Under this heading we notice the following:—"Annuaire pour l'An 1872, Publié par le Bureau des Longitudes." "Manuel Pratique et Elémentaire d'Analyse Chimique des Vins," par E. Robinet; this work is highly spoken of by the excellent editor of *Les Mondes*, and it is stated to contain a very perfect *resumé* of all that is scientifically known about wine and the methods of testing it. "Studi Sopra gli Strumenti Magnetici," par l'Abbé Braun, S.J.; this work, on the magnetical instruments required for making observations on magnetism, is here stated to be the most complete and precise ever published; the author has charge of the instruments of the Observatory of the Collegium Romanum at Rome.

Le Moniteur Scientifique Quesneville, Nos. 359 and 360 (one number), December 1 and 15, 1871.

This number does not contain any original papers relating to chemistry, but we call attention to a paper on a—

New Kind of Diving-Bell.—A. Guiot.—Illustrated with woodcuts.

Bulletin Mensuel de la Société Chimique de Paris, April, May, and June (one number), 1871.

This number, just published, contains only the following original essay:—

Ammoniacal Platinum Bases.—P. T. Cleve.—This lengthy essay, chiefly a series of formulæ, is divided into the following sections:—Introduction, containing a general review of this subject; combinations of hydroxyl-sulpho-platino-diamine; bromo-sulpho-platino-diamine; combinations of aceto-hydroxylo-platino-diamine; action of bromine on the basic nitrate of diplatino-diamine.

La Revue des Scientifique de la France et de l'Etranger, December 23, 1871.

This number does not contain any original papers relating to chemistry, but we call attention to a very important memoir:—

On Free Universitary (Higher) Instruction.—Dr. P. Lorain.—This paper contains a valuable and excellent *resumé* on the labours of those who, in 1870, by order of the then French government, visited various civilised countries of Europe and America to inquire into the subject of universitary instruction and education.

December 30, 1871.

This number does not contain any original papers relating to chemistry, but we meet here with a continuation of the paper just alluded to, under the title—

The Catholic Party and Higher Instruction.—P. Lorain.

The American Journal of Science and Arts, December, 1871.

This number contains no original papers on chemistry, but as usual we meet here with several memoirs relating to geology, astronomy, botany, physical geography, and zoology.

NOTES AND QUERIES.

Canadol.—Will any of your readers say what canadol is composed of; where is it made in quantity; what is the number of patent if it is patented?—R. F.

Phenyl-Citramic Acid.—(Reply to S. E. P.)—You are right; phenyl-citramic acid has only one atom of N to eleven of H. The French edition from which the English translation was made has the same error.—T. S.

Stannate of Soda.—Can any of the readers of "Notes and Queries" inform me on the following points:—Is there an active demand for stannate of soda? In what form is it usually sold—crystalline, liquid, or amorphous? What is its present value per unit of tin?—C.

The Oxidising Power of Solutions of Permanganate of Potash.—Ammonia is not converted into *nitrate* of potash, as stated through an unfortunate error, but into *nitrite* of potash. In other words, permanganate of potash solutions convert ammonia into *nitrous acid*.—HUGO TAMM.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 29th.—Medical, 8.
—— London Institution, 4. Prof. Odling, F.R.S., on "Elementary Chemistry."
TUESDAY, 30th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
WEDNESDAY, 31st.—Society of Arts, 8.
THURSDAY, Feb. 1st.—Royal, 8.30.
—— Chemical, 8.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
—— Royal Society Club, 6.
—— London Institution, 7.30. Reading and Discussion of a Paper by Mr. Hyde Clarke, "On the Necessity for a Minister of Commerce."
FRIDAY, 2nd.—Royal Institution, 9. Prof. Tyndall, F.R.S., "Remarks on the Identity of Light and Radiant Heat."
—— Geologists' Association, 7.30. Anniversary.
SATURDAY, 3rd.—Royal Institution, 3. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

TO CORRESPONDENTS.

R. Gregson.—Wagner's "Chemical Technology;" an English edition is in the press.

J. Mayer.—Arrived too late for this issue.

M. A. G.—Your communication is unsuitable for our "Notes and Queries" column; it should be an advertisement.

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British Association for the Advancement of Science (Office, 22, Albemarle Street).—The NEXT ANNUAL MEETING of this Association will be held at BRIGHTON, commencing on WEDNESDAY, August 14th, 1872.

President Elect—WILLIAM B. CARPENTER, M.A., F.R.S. F.G.S., F.L.S.

Assistant General Secretary—G. GRIFFITH, M.A., Harrow.

London International Exhibition of 1872.—TENDERS are invited for the privilege of TAKING and SELLING PHOTOGRAPHS. Conditions may be obtained on application to the Secretary, Upper Kensington Gore, on and after the 18th of January. Sealed tenders, marked "Photographs," must be sent in by noon on the 15th of February. Her Majesty's Commissioners do not bind themselves to accept the highest or any tender.—By order,

HENRY Y. D. SCOTT, Major-General, Secretary.

Geological Mineralogy, King's College, London.—PROFESSOR TENNANT, F.G.S., commenced the Second or PRACTICAL DIVISION of his LECTURES on Minerals and Rocks on Wednesday Morning, January 24th. The Lectures will be continued on each succeeding Friday and Wednesday at 9 a.m. Fee, £2 2s.

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THE CHEMICAL NEWS.

Vol. XXV. No. 636.

NOTES OF
DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

IX.

For the elaboration of blood food has to pass through certain processes in the intestinal canal; these are generalised under the term digestion. During the comminution which food undergoes in the mouth it is mixed with saliva, a viscid, colourless fluid secreted by the parotid and other glands of similar structure.

Fresh saliva is alkaline; it contains potash salts, phosphate of lime, sulphocyanogen, and an active principle (ptyaline); it has a sp. gr. of about 0·1008 (Wright); its solid residue is small. 100 parts contain—

	According to Berzelius.	According to Simon.
Water	992·9	991·225
Solids	7·1	8·775
	1000·0	1000·000

1000 parts of saliva are said to contain 2·9 parts of ptyaline. The active principle may be extracted from saliva by evaporating to dryness, washing with alcohol, and dissolving in water, in which it is soluble.

Saliva lubricates the throat and mouth, assists in comminuting the food, and dissolves soluble substances to render them capable of being tasted.

The pytaline acts in converting starchy matter to sugar in much the same way that the "diastase" of plants does, setting up an action which continues without additional ferment. The presence of sulphocyanogen in saliva may be tested by a per-salt of iron.

The pancreas secretes a fluid similar to saliva in its constitution and action, it contains an active principle identical with ptyaline, it also contains considerable albumin, it is supposed to be capable of assimilating fats, and has lately had attributed to it the power of dissolving albumin.

The gastric juice secreted by the follicles of the stomach is, perhaps, one of the most important fluids of the body. This secretion is a viscid, clear fluid, having a free acid reaction (prob. lactic), an active principle (pepsine), and salts, especially phosphates.

It has the following percentage composition in 1000 parts:—

Water	984·00
Organic matter	10·52
Soluble salts	5·02
Insoluble salts	0·46
	1000·00

This fluid is comparatively simple, and has a very definite action; by the aid of its pepsine albuminous matters are attacked and dissolved: this is readily demonstrated by putting into a mixture of pepsine and water with a little HCl any albuminous body, and subjecting the whole to a temperature of 45° C.; in the course of a few hours it will be converted into chyme.

Gastric juice is useful, no doubt, in a more extended sense than we attribute to it. Tuson has lately found that insoluble salts, as calomel, are attacked and dissolved by it, thus accounting for their ready assimilation; it must, however, act differently for various substances, and it is doubtful whether any fixed rule can be formed regarding them.

Pepsine, which is extensively used in debilitated states of the digestive organs, to assist them in dissolving food, may be obtained from the fresh stomach of any animal by macerating in water and precipitating with acetate of lead; H_2S passed through the suspended precipitate separates the lead, and leaves the pepsine in solution, which may be dried by evaporation. Messrs. Bullock and Co. are said to prepare it without lead.

Besides these secretions there are others of minor importance discharged from small glands at various parts of the intestinal canal, and also the bile, of this we shall treat separately.

The result of the action of saliva and gastric juice on food is to produce a pultaceous mass which is called chyme, certain portions of which have been converted into a modification of albumen termed peptone; this chyme then passes from the stomach to the duodenum, and there becomes further modified by the pancreatic juice and bile. On passing down the intestines it meets the villi, which are actively engaged in abstracting the nutritious portions to be conducted along vessels called lacteals, to a receptacle destined to receive this new fluid, or chyle; from this reservoir it passes upwards through a duct to the left subclavian vein, and there mingles with the blood about to return to the heart, from whence it is forced into the lungs, and, having undergone oxidisation, is converted into blood ready for the nutrition of the body.

The refuse from which the chyle has been drained is then cast off into the draught.

IMPROVED LABORATORY ARRANGEMENTS.[*]

By H. KOLBE.

New and improved conveniences for chemical laboratories deserve to be brought into general notice for imitation; and obeying this precept, I purpose to describe the ventilating arrangements by which the working-room of the new Leipzig laboratories are continually supplied with fresh air.

No building requires good ventilation in its apartments more than laboratories, when often thirty or more inexperienced young chemists experiment together in one room and load the air with vapours and foul-smelling gases. Even the skilful and experienced cannot always avoid thus vitiating the atmosphere of the workroom.

In the construction of the above-named laboratories great care was used to secure thorough ventilation.

Small steam-drafts, placed in the jambs of the windows, as first arranged by Hofmann in the Bonn laboratory, contribute somewhat to the purification and renewal of the air; but these do not exhaust sufficiently to render the air continually pure. Moreover, it is hardly possible in winter, with closed doors and windows, to have several of them in operation at the same time. The quantity of air, which finds entrance through the cracks of the windows and doors and through the porous outer walls, is less than that which the ten flues, leading from as many steam-jets, as in each workroom of this laboratory, can withdraw. The consequence is that the flues most heated and with the best draught have a very good upward air-current, while through the rest the current is downward. In this case it is of no avail to light gas-flames in the flues with contrary draughts. But the currents take their normal direction almost immediately, when by opening a window or by any other means the outside air is admitted in sufficient quantity.

This is effected in the new Leipzig laboratories in the most simple way and permanently by a broad flue,[*] which

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[*] Translated by Elwyn Waller, E.M. From the *Journal für Praktische Chemie.*

[*] The area of this must correspond to the size of the room. In the room under consideration, with a capacity of 650 cubic metres, the flue 11 metres in height, has an area of 0·65 square metre (8 square feet).

is built up in the cellar from the level of the surrounding yard or gardens and discharges in a corner of the room two feet below the ceiling. This draws up from the outside, through a wide opening made in the side, good pure air, and conducts it to the room above; in winter it is warmed by a coil of steam-pipes placed therein.

Through this continued influx of a large quantity of properly heated air, the atmosphere of the room attains a certain pressure, which suffices to cause a good current upward in all the fore-named ten flues of the steam-draught at the same time, if required, and warming them with gas-flames is generally unnecessary.

When the air-supply which these ten steam-draught flues, all working together, which is seldom the case, are able to carry away, is insufficient for the perfect ventilation of the room, there is provided, in the corner of every room, diametrically opposite to the supply flue, a second flue of similar dimensions closed below, into which (from the room) lead one or two broad side openings which may be closed partially or entirely by slides, and which will take as much air from the room as the other air-channel can supply. Of the two openings, one is just above the floor, the other is just below the ceiling, and these, according to circumstances and observations of what is needful to maintain the draught, are set more or less widely open.

To heat these exit-flues has been proved to be almost unnecessary, though undoubtedly this arrangement assists the matter much. The laboratory should possess a flat roof, provided with so-called wood-cement covering,* above which 150 chimneys altogether rise a distance of several feet, and with no other high building in the neighbourhood.

I have made the following test to prove the working of this ventilating arrangement. In one of the larger laboratories, while both the inlet and outlet air-flues as well as all the steam-jets were closed, I caused to be placed in several places about the room dishes containing hydrochloric acid and ammonia, near to one another, until the hall was filled with dense sal-ammoniac fumes, so that one could not see further than a metre in any direction. Thereupon the two ventilating apertures on opposite sides were thrown open. In the course of 15 minutes the air streaming through had already diluted the sal-ammoniac fumes to such an extent that one could see from one end of the hall to the other. After 15 minutes more the fumes were not more dense than ordinarily prevail in unventilated laboratories where several work together; and after 45 minutes in all, the atmosphere was entirely clear.

When one considers that such a stream of air pours through the laboratory throughout the day, and in summer through the night time also, he need not wonder that a good pure air always prevails there, so far as is in general possible in a chemical laboratory.

The establishment of this system of ventilation is extremely simple and easy, but it is by no means unimportant what the dimensions of the inlet and exit air-channels are. If these are built too narrow, the supply of air is not adequate to the needs, and, moreover—what is a still greater evil—at the same time there exists in the rooms to be ventilated an unendurable strong current of air. A broader air-channel, through which a larger current of air moves with less velocity, causes much less of an air-current in the room. The dimensions given above, and the relation of the breadth and the height of the air-supply channel to the size of the given room, are here fortunately so suitably chosen that, with full ventilation in the laboratory, in no place is there a disturbing current of air, and on all the desks the gas-flames burn quietly.

Heating.

For heating a large space, complicated in construction, simultaneously and uniformly, central heating should be most recommended. Of the three systems for this of air-, water-, or steam-heating, in the establishment of the laboratory of which I speak, I have given the preference to the latter, for the reason that in the laboratory the steam finds at the same time various other uses.

From the underground steam-boiler, about in the middle of the building, the steam goes to 30 rooms, which are to be heated with 46 heaters, and also, by means of iron pipes beneath the floor, heats the large lecture-room. The heaters are so arranged that one can at pleasure admit much or little steam to them, or shut them off altogether, without the steam-heating in general suffering interruption. The water condensed in the pipes and heater flows back to the steam-boiler, by which arrangement a great saving in fuel and also in water is effected. With these arrangements, when the weather is not too cold, if the boiler is heated up about 6 o'clock in the morning, all the laboratories are uniformly and comfortably warm by about 9 o'clock.

A second series of pipes, leading from the steam-boiler, serves to the application of steam to special chemical purposes, principally for obtaining distilled water, and at the same time for heating the copper drying-chambers.

These last are so constructed that the steam enveloping single cells enters below and also a few inches above the lower bottom of the drying chamber, and makes its exit on the opposite side above, and then through tin pipes is carried to the cooling-vessel for condensation.

With this disposition, the mechanically suspended impurities from the iron pipes are deposited in the drying-chambers, and the steam proceeding from them furnishes very pure distilled water.

The hot water condensed in the drying-chamber is from time to time drawn off at the spot which serves for cleaning the apparatus, &c.

The steam finds another application for heating the separate water-baths placed about in the laboratories. Instead of having numerous small water-baths for heating dishes containing solutions, &c., which need to be heated with charcoal, spirits, or gas, and in which the water may readily boil away without careful attention, for the majority of these cases a few larger water-baths serve, which are fed with steam from the steam-boilers. These consist of copper boxes 1 metre long and 0·6 metre wide, but low (at most 7 c.m. high), whose upper surface has several large and small round apertures for the reception of the evaporating dishes. These openings, moreover, can be closed by a sliding cover. Into the boxes, which stand in a niche provided with a perforated plate of slate, the niche having in front a glass sliding-window, the steam flows through one of the diagonally-placed copper pipes, provided with several fine holes, from which it is spread uniformly through the water-bath. The condensed water flows through a lead pipe provided for it into the general exit canal. These steam-baths have the advantage over the small water-baths that they may be put in operation at any moment. One needs only to open the cock to let the heating power of the steam operate. Among the applications of this steam-heating belong also, in fine, the ability of using the steam for various other purposes, *e.g.*, for rapid heating of water by directly conducting steam into it, for distilling, &c., if the necessary simple arrangements are made for it. For this nothing more than

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* This kind of roofing wears extremely well, and possesses in general a number of advantages. The layer of sand and coarse gravel, from 5 to 7 c.m. thick, which forms the upper surface of the flat roof and gives it the appearance of a paved road, makes the roof thoroughly uninjurable by the strongest hailstorm, and protects the building from catching fire from burning pieces which may fall upon it, should a fire accidentally occur in the nighbourhood. Besides this it resists strong gales, violent winds. In December, 1869, when the roofs of all the neighbouring houses suffered more or less serious damage in the heavy storm at that time, the wood-cement roof of the laboratory remained quite undisturbed. The fine attics of buildings so roofed are, in contrast to those houses roofed with slate or with zinc, cool in summer, and protected to a certain degree in winter against cold, so that they afford habitable rooms which are easily warmed. An additional advantage of this roofing is that, with its simple foundation, its cost is only half as much as a roof the same size of English slate or of zinc. It is remarked as a curious circumstance, that in Leipzig, where wood-cement roofs are already moderately plentiful, one finds upon them small gardens with flower-beds and shady arbours.

coupling-cocks, leading from the steam-pipes, and strong india-rubber hose upon them, is needed. In the laboratory of which I speak these cocks are in various places, especially in those laboratories devoted to the preparation of various compounds, and they come into general use.

The amount of steam which is used for what I have called special chemical purposes, is so small in comparison to the amount which serves for the heating of the rooms, that it scarcely noticeably increases the expense which the steam-heating entails, and this evidently makes a great saving in the laboratory. For the generation of steam for the purpose of obtaining distilled water, heating the drying chambers and water-baths, &c., during the summer, to avoid having to heat up the large steam-boiler, a small boiler placed near by is used, which works with a pressure of one atmosphere, and from which the steam is conducted through the same series of pipes to the most remote portion of the laboratory.

Sulphuretted Hydrogen Arrangement.

The most unpleasant guest in a chemical laboratory is the inevitable sulphuretted hydrogen. To get rid of the exceedingly irritating odour of this gas in the building of the laboratory, I thought out an unusual plan, to attain a suitable result, which would render it possible to banish this disagreeable odour from the rooms. The results have justified my expectations—indeed, more than justified them; and I desire here to describe this arrangement in the laboratory, which has proved so successful.

A gasometer, similar in design to the sulphuretted hydrogen gasometer, which Städeler has put up in the laboratory of the Zurich Polytechnic school, is placed in the cellar of the laboratory; this resembles in construction those of the illuminating gas companies (1·6 metre diameter and 2 metres high). This is filled from a neighbouring chamber, by means of a large generating vessel, which is so arranged that it can be taken out closed and emptied in the open air, and again be re-charged with sulphide of iron and hydrochloric acid. During the disengagement of the gas itself no smell of sulphuretted hydrogen is perceptible. Moreover, the water, which serves as a hydraulic valve to the gas-holder, is on the outside of the gasometer proper, covered with a film of oil, which prevents the exhalation of the sulphuretted hydrogen from the water saturated with it.

The gas collected in the gasometer is used in two rooms, one above the other, on the ground-floor and first story, which are in close connection with the 28 metre (100 Saxon feet) high chimney, which creates a draught for the fire under the steam-boiler, and is, moreover, arranged to draw off all the sulphuretted hydrogen which escapes as superfluous from the gas-pipes in both rooms. This is attained in the following manner:—

At the back wall of the room of which I speak, opposite the window, on a long narrow table, stands an arrangement with a number of small wooden closets of about 6 dcm. high, 2·5 dcm. broad, and 3 dcm. deep; each of these is provided with a glass door with two sashes, the lower of which may be raised by the wooden frame. These chambers run to a line in the back, and terminate in a slit reaching from top to bottom of 4 c.m. width. All the chambers connect, by these slits, with a horizontal canal, common to all, of the same height as the chambers, and 8 c.m. deep, also of wood, which leads through a hole in the wall, made for the purpose, into the chimney close by. The end piece of this canal, so far as it passes through the wall, is made of sheet-zinc.

The draught of the chimney is so strong, when one of the doors to the small chambers is opened a hand's breadth, it slams too with violence if let go. One can readily infer how thoroughly, with such a draught, all sulphuretted hydrogen which escapes into the chamber is drawn off. The leaden pipe placed above the chambers and attached to the wooden back wall, closeable by a cock, communicates with the sulphuretted hydrogen gasometer and conducts the gas into the chamber by a pipe connecting with it at right angles, which is bent downwards, and passing through the middle of the cover descends 5 c.m. into the chamber, so that over the end an india-rubber tube may be conveniently fitted. Each supply-pipe at the top of the chambers leading from the main pipe carries an ordinary gas-cock, and besides this also a second close behind it for closing the whole arrangement. This last is a cock only opened and closed by a key belonging to it. This second closure is intended to prevent the waste of the sulphuretted hydrogen, and is therefore so set, once for all, that even when the forward cock is wide open only a little gas can pass through.

The vessels containing solutions into which the sulphuretted hydrogen is to be introduced are placed in the chamber, a glass tube connected with the supply-pipe by rubber tubing inserted, and the cock opened. While the gas is on, the sash of the chamber should be somewhat open.

When such a vessel in one of the chambers breaks or is upset, in order to prevent its contents from running into the channel, or running over in front into the room, the bottom of the chamber is secured front and back with a wooden ledge, a finger's breadth in height, and moreover provided in the centre with a round hole through which the spilled liquid flows into a length of pipe, under the table, having a slight inclination, which discharges through a vertical extension into a capacious stationary jar.

Next to the eight small chambers there is a ninth larger one, with two glass doors, on an extension of the table. This is 5 dcm. wide, 5·5 dcm. deep 6 dcm. high, and communicates also in the back by a vertical slit with the draught-flue running to the chimney. This larger chamber is partly intended for the reception of larger vessels, which cannot conveniently be introduced into the small chambers, and partly for the application of sulphuretted hydrogen to such solutions as of arsenic acid, which during treatment with sulphuretted hydrogen must be heated. For this purpose, at the side of the table is a gas-cock, to which is attached by means of tubing a burner within the chamber itself. The roof of this chamber is covered on its under side with sheet-zinc to protect the wood from the heat radiated.

Both the rooms in which the sulphuretted hydrogen arrangements described are situated are so placed that one cannot enter them directly from the laboratories. The way leads from this, first through a passage communicating, and from there through the hall used for the preparation of compounds. Further precaution is taken that the solutions freshly impregnated with the gas shall be filtered from their precipitates in the sulphuretted hydrogen room itself.

In order to get rid of the little sulphuretted hydrogen which escapes thus into the air of the room, there is an opening in the wall leading directly into the large chimney, which may be closed by a sliding plate. With a strong draught in the latter it suffices to open the aperture for a few minutes in order to purify the air of the small room thoroughly and replace it by fresh air.

ASSAY FOR GOLD AND SILVER.

By T. M. BLOSSOM, E.M.,
Assistant in Charge of the Assay Laboratory of the School of Mines, Columbia College.

(Concluded from p. 39.)

2. *Gold Coin and Bullion.*

The assay of gold coin and bullion comprises two determinations, (*a*.) of copper or base metal, and (*b*.) of gold. The difference between the sum of these two and the total weight of bullion represents the amount of silver.

(*a*). Base metal: Cupellation.

If the alloy contain no more than 20-1000ths of copper, weigh out 0·500 grms. and cupel with half a sheet of lead.

If it contain more than 20-1000ths of copper, cupel 0·250 grms. of the alloy with a whole sheet of lead.

If a large amount of silver be present, couple 0·500 grms. with a whole sheet of lead.

The copper is scorified and carried into the cupel by the litharge, leaving a button of the gold and the silver, if there be any, contained in the alloy.

A check-assay is made with every set of assays. We employ for this purpose a proof-alloy containing 850 parts gold, 12 parts copper, and the rest silver. This ought to lose by cupellation just the 12 parts copper. It may lose more or less, and, according to the difference one way or other, we correct the regular assays which have been made under the same conditions. Suppose the check-assay yielded 11·8-1000ths copper; 0·2-1000th has been retained, and the proportion of copper obtained in each of the regular assays must be increased by this amount. If the check-assay had yielded 12·2-1000ths as the proportion of copper, it would be known that 0·2-1000th of silver had been lost, and the proportion of copper obtained in each of the regular assays would be diminished to this extent.

(*b*). Gold: Parting.

We take for this operation a certain weight of the alloy, 0·5 grm., and add to it such an amount of silver as, when added to that already present, will make the silver twice the amount of gold. The reasons for doing this have been stated already under the head of "Inquartation and Parting" in the assay of ores. If there is no silver in the alloy, the approximate amount of gold is given by the assay for base metal, whence the quantity of silver to be added. If the alloy contain silver, the assayer must rely upon his own judgment, guided, perhaps, by the touchstone, or by comparative slips of known fineness, unless he choose to take the trouble of parting the button obtained in the previous operation. Wrap the alloy (0·5 grm.) and silver in a sheet of lead, and cupel it.

If the alloy be above 950 fine, add say 0·005 grm. of rolled copper, to toughen the cornet. This addition should also be made in the fine gold proof.

The button obtained from cupellation is hammered on the anvil to flatten it somewhat. Three blows with a light hammer will suffice; the first simply to flatten, and the two others directed in such a way as to give the flat button an elongated form. It is then heated to redness in a clay annealing cup placed in the muffle, and afterwards is passed between the rolls of a small flatting-mill. When rolled sufficiently thin the ribbon is again annealed and wound into a cornet or spiral round a small glass rod. The button must be reduced to a suitable thickness on the one hand in order that the silver may be dissolved completely, and on the other that the gold cornet may remain whole after the operation of parting.

Parting.—The cornet is next subjected to the action of nitric acid in a glass mattrass of about 3 ozs. capacity. Pure acid, absolutely free from chlorine, is added at different intervals, and heat applied. Acid of two different degrees of strength is employed. The first has a sp. gr. 1·16 (21° Baumé); the second, a gravity 1·26 (32° Baumé). The reason is that if very strong acid were used at first, in the presence of considerable silver, the action would be too brisk, and might break up the cornet; and, on the other hand, the weaker acid would not remove the last traces of silver, which are difficult to separate. Enough acid (about one half-ounce) must be added in each case to cover the cornet completely. First, pour on acid of 1·16 sp. gr., and heat for ten minutes; replace this by acid of 1·26 sp. gr., and boil ten minutes; decant, and make a second boiling with acid of the same strength (1·26) for another ten minutes. A gentle boiling is intended, and not a tumbling about of the cornet. It is customary, indeed, to add sometimes a small piece of *thoroughly carbonised* charcoal, to prevent bumping of the cornet. Finally, the cornet is washed with distilled water, the flask is filled completely with water, a porcelain crucible or capsule is placed over the neck, and the whole is inverted. The cornet falls gently through the water into the capsule, the flask is removed, the water decanted, and the cornet dried, and annealed in the muffle. The weight of this cornet gives of course the total amount of gold in the sample assayed. The gold, copper, and silver are reported in thousandths, as in the assay of silver bullion.

We make in this determination, as in the previous one, a check-assay with each set of coin or bullion assays. The metal used is pure gold; and as the standard fineness of the gold coin of the United States is 900-1000ths pure gold, the test-assay is made upon 900-1000ths of a ½ grm., when United States coin is being assayed. The regular assays are corrected, as in the previous determination of copper, according to the indications of the test assay.

3. *Native Metal and Alloys.*

Rough metal in scales, &c., left on the sieve during pulverisation of ores.

The assay of the above material consists ordinarily of scorification, cupellation, and parting. The quantity of test-lead for scorification would vary in every case; but an appreciation of what has been said already concerning scorification will enable the assayer to judge of the proper quantity.—*American Chemist.*

ON THE MANUFACTURE AND REFINING OF SUGAR.*

By C. HAUGHTON GILL.

(Continued from p. 42).

Lecture III.

I shall enter to-night upon the consideration of a process of manufacturing sugar from beet-root. I say a process, because there is more than one employed, and I shall not have time to describe them all. I shall therefore describe the process which, up to a recent time, at any rate, has been most generally employed, and which is, on the whole, the most simplest to understand. I shall not enter into the nature and culture of the beet-root, for it has been very ably discussed before in this room, and I can add nothing whatever to what has been said on the subject. The roots, however, I may say, require tolerably deep soil, and when grown under fair conditions, yield a crop of from 16 to 20 tons per acre. On the table are some specimens of roots grown in England, for which I am indebted to the kindness of one of the large London sugar refiners, Mr. James Duncan, of Lavenham. Some of these sugar-beets are rather larger than is considered good as a rule, for it is found that the larger beet-roots, generally speaking, contain juice much poorer in sugar than smaller ones. A root, to satisfy the requirements of a sugar-maker, should be of a regular shape, and free from rootlets. One of these I will cut in half, that you may get a general idea of the internal structure. You see that it is built up of a number of concentric rings, which, of course, are formed of a great number of small cells, each cell being filled with juice, that is to say, a watery solution of many bodies, including sugar. Of the non-saccharine constituents I may mention the phosphates, oxalates, citrates, malates, and chlorides of potassium, sodium, and calcium, some bodies resembling albumen, if not identical with it, and other gum-like, but little known, substances belonging to the class of colloids. Besides these, there is a small quantity of a material which rapidly changes colour when exposed to the air, and becomes black, just as a similar body does which is contained in the juice of walnut rinds. The percentage of sugar in these white beets varies greatly. I have analysed English grown roots with as much as 16 per cent of sugar, and others with not more than six. To what a degree of richness the roots may be brought

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* The Cantor Lectures, delivered before the Society of Arts.

is shown by the fact that some Austrian roots have been found to contain 18 or even 19 per cent of sugar in the juice. The object of the sugar maker when he has got the juice is, of course, to remove as many as possible of these impurities, and then to get out from the remaining liquid as much of the sugar as possible. I will point out, later, a reason why he is unable to extract the whole of the sugar from the juice that he wins.

The first operation performed in a beet-root manufactory is to wash the roots, which is done by a machine made for the purpose. This washing, which ought to be performed very carefully, being over, the roots are passed onwards, and are freed from the upper part, or crown, from which the leaves spring, and also from any worthless or decayed portions which may be noticed upon them. They then go to a machine, in which they are rasped up into a fine pulp. I have not a diagram showing the structure of this machine, but it practically consists of a drum, from 18 inches to 2 feet in diameter, and 2 feet long, the whole circumference of which is set with a number of saw blades, with teeth just sticking out of the circumference. This drum is caused to rotate with great rapidity, performing between 700 and 1000 revolutions in one minute. Near to it is a straight steel edge, and as the roots are passed into the hopper of the machine they fall down, and are rasped against these rotating saw teeth and, of course, as the teeth come round, they scrape out from the root a number of small strips, and gradually the roots are rasped up into a sort of pulp. Here is a specimen of the pulp, produced by an ordinary grater, which has somewhat changed colour, owing to the presence of the bodies which I just now mentioned. This pulp, which in practice is much wetter than this, because the manufacturer allows water to run into the machine while the roots are being torn up, is next folded up in a number of cloths made of coarse flannel; the pulp is put into the centre of the cloth, the edges of which are folded over, so that it is made into a kind of square cake. It is then put upon an iron plate, another plate upon the top, then another cake of pulp, and so on, till there are fifty, sixty, or seventy cakes piled one above the other. These packets are all put into a powerful hydraulic press, which is caused to exert a gradually increasing, but finally very great, pressure on the mass. Of the 95 or 96 per cent of juice which the roots contained 80 to 85 are obtained by this method. Where the process of diffusion is adopted 94 to 95 per cent is the practical yield of juice. The juice, as it is pressed out, runs in a vessel prepared to receive it, in the same way as it does from this mass which I squeeze with my hand. It is then somewhat dark-coloured, as it contains all the impurities I mentioned before, and has now to be clarified. If we simply boil it, as I have boiled some similar juice here, we do get a partial clarification, for the albuminous constituents coagulate in the same way as the white of an egg sets when it is heated, and form a kind of scum on the surface. The coagulation is by no means very perfect. But it is found that by the addition of some lime the process of coagulation, and consequent running together of many of the other constituents, is very much facilitated, owing to the formation of insoluble lime compounds. But this addition of lime prevents the coagulation of the albumen itself, which, therefore, remains in solution till it is partially destroyed by being boiled in the alkaline solution.

To illustrate this, I have put into a beaker a quantity of beet-root juice, and I will now add a small quantity of milk of lime, that is to say, ordinary quick-lime which has been slaked in water, and then stirred up to a thin cream. I will stir the two together, when the effect is, that the liquid immediately appears to grow whiter in colour, and there is now a quantity of small clots formed in the liquid. These will gradually collect together, and rise towards the surface, forming a kind of scum, and we find below a clear liquid of a moderate yellow colour. The juice will thus be clarified, or, as it is technically termed, defecated. This defecation is performed on a large scale in this way. The juice running from the presses is allowed to go into some large copper heaters, holding about 500 gallons each, and to each of these a quantity of lime is added which is equal to about 1 per cent of the weight of the roots from which the juice has been obtained. Before the lime is added, however, the juice is heated to a temperature of about 180° F. The lime being added, the coagulation commences, and then the heat is raised slowly by turning steam into the pocket of the pan. As the liquid approaches boiling-point, a scum arises in the way I have described, and as you will see take place here in a few minutes. I can show you the effect more easily by exhibiting a sample which Mr. Duncan has sent me of the juice after it has been clarified. Here is some of the original juice, which comes from the sugar factory at Lavenham, not only the first, but the only beet-root sugar manufactory in England; and here is some which has been subjected to the treatment I have described. It has been heated, the lime has been added, the scum has been allowed to rise, and the clear liquid has been drawn off. You will observe the great difference in the apparent purity of the product. I should add, in fairness, that this purification is even greater in appearance than it is in reality, for the quantity of impurities removed by this process of defecation is much smaller than the change in appearance would lead one to suppose. The next stage of the operation is this:—The juice defecated by the action of the lime contains still a considerable quantity of lime in solution, for though much of the lime which has been added has combined with the organic acids and other matters which were present in the juice, and has separated in the form of scum, still a great portion remains behind, and gives to the juice a distinct alkaline character, which, as I explained to you last time, is detectable by means of a turmeric or litmus test-paper. I have not explained exactly what I mean by alkaline character, but have only told you it is that character which lime, soda, and potash possess of neutralising acids and turning vegetable colours in the way I have shown. I pointed out, for instance, that an alkaline solution is capable of turning turmeric paper brown, and by applying this test to some of this defecated juice, you will see that it is distinctly alkaline in its character. That is due, at any rate for the most part, to the presence of an excess of lime dissolved in this weak solution of sugar. Before the manufacturer can advantageously treat the solution so as to obtain sugar crystals, he is compelled to remove a great part of this lime by some process or another; and that which on the whole is most economical and most usually applied is by causing the lime present in such a solution to unite with carbonic acid gas, which, as I showed you before, forms a compound which is insoluble or very slightly soluble in a sugar solution, and thus separates in the shape of a white powder.

I can show that, in this particular case, by passing some carbonic acid gas into this solution, which, however, should have been boiling hot, as the decomposition would have been much quicker. I dare say you can see, however, that the liquid has become cloudy, and this cloudiness is due to the fact that the carbonate of lime formed by the absorption of the carbonic acid by the lime held in solution is insoluble in the solution of sugar, although the lime itself is exceedingly soluble. This solution, after it has been well saturated with carbonic acid and boiled, will have lost, in a great measure, its alkaline character, but not entirely so; for this alkaline character is due not alone to the presence of lime, but also to the presence of some bodies, such as soda, which have been liberated from combination by the lime previously added, and they, being soluble, do not fall to the bottom. When this operation is performed on a large scale, the workman continues to pass gas into the hot solution until he finds that the precipitate which forms clots together pretty readily, and sinks rapidly to the bottom of the vessel. He takes this as an indication that the operation is practically complete, the settling of the precipitate marking the termination of the action, and showing that nearly all the lime has become combined with carbonic acid, so as to become insoluble. I will filter some of this solution—when you see it is pretty bright, and of a somewhat paler colour than it was before. This diminution of colour, which really takes place when the operation is performed carefully, is greater in proportion to the quantity of lime that was present before carbonation, and is due to the fact that the carbonate of lime, as it is formed and precipitates, combines in a loose sort of way with a certain quantity of the colouring matter present, and carries it down into the sediment. In fact, the carbonate of lime forms with the colouring matter a kind of "lake," in the same way as alumina forms the ordinary lakes used in painting, when it is precipitated in a solution containing a vegetable colouring matter. On proving this filtered solution with the turmeric paper, you see that the colour produced is much lighter, and by the continued saturation of the liquid with carbonic acid, this change would have been more marked. I must now show you another experiment. In this glass I will put merely a solution of lime in water, adding some more distilled water to make it weaker. I will now pass carbonic acid gas into that. You immediately see the action takes place; the lime combines with the carbonic acid, and forms carbonate of lime, in the same way as it does in the solution of sugar. But what I want you to observe in this experiment is this, that on continuing to pass carbonic acid into the lime-water, until it is present there in excess, the carbonate of lime which was first precipitated will be dissolved, that is to say, the excess of carbonic acid re-dissolves the carbonate of lime first formed. It is very important to establish this point, but you must remember that this only takes place permanently in a cold liquid. Thus, if we heat the solution so obtained to the boiling-point, the carbonate of lime which has been dissolved owing to the excess of carbonic acid will be re-precipitated again. It is necessary to remember this, in order to understand why, when in a sugar factory they pass carbonic acid gas in to precipitate the lime held in solution by the gas, and, when the action is apparently complete, they are obliged to boil the liquid pretty vigorously for some time, for if they did not do so a quantity of the carbonate of lime which had been first precipitated would remain in solution, being re-dissolved by the excess of carbonic acid, and, what is worse, at the time the carbonate of lime is dissolved there is also dissolved the organic matter which that carbonate of lime previously carried down with it. You see, no doubt, this solution is already becoming clear again, the carbonate of lime being dissolved by the excess of carbonic acid; but upon boiling the clear liquid, you again see, as it gets hot, the excess of carbonic acid present is given off in bubbles, and in a few minutes the carbonate of lime dissolved will be re-precipitated, though not quite in the same way as before, but in a much more crystalline form, and it will adhere much more to the side of the glass, and therefore be less visible.

Supposing that this operation has actually been performed in the factory, that the juice has been first defecated, then saturated or carbonated with carbonic acid, that the excess of lime in the juice has been removed by carbonation, we get such a product as is contained in this bottle, which also comes from Mr. Duncan's factory. The juice has now, in a great measure, lost its alkaline character, having been deprived of a greater part of the dissolved lime by means of carbonic acid. There is, however, still some lime to be removed from the juice, and there are also contained a considerable number of those gummy and albuminous bodies which I before mentioned. These are partially removed, and at the same time a considerable portion of the colouring matter which gives this brown tint to the quid, by passing the juice through animal charcoal. This is done by taking the juice coming from the carbonating pan into an iron cistern, and there heating it nearly to boiling-point, and from there passing it into the top of tall vessels 15 or 16 feet in height, and 2½ to 3 feet in diameter, and filled with granulated animal charcoal. The juice finds its way through this charcoal gradually to the bottom, and runs out while a fresh supply is poured in at the top. As I showed you last week, the animal charcoal has a considerable power of absorbing bodies, such as dextrine, and if you give it a longer time and the liquid be hot, as in the case under consideration, the action is considerably increased and the liquid undergoes a very material purification. I have here some juice which has been defecated, carbonated, and also passed through the animal charcoal; and you will observe that the result is very much less coloured, the juice now being a very pale yellow tint, and a great portion of what small quantity of lime had been left in it by the carbonating process has been now removed, together with a material portion of the gummy matters. The carbonated juice might be sent up to the cisterns, in which it is held before it comes down to the animal charcoal, by means of common pumps, but it is not found advisable to do this in a beet-root sugar manufactory, because the inside of a pump is not very readily cleaned; and when beet-root juice is allowed to hang about, for even a comparatively short time, it begins to undergo a kind of fermentation; and when the juice contains, even for a very short time, any fermenting body, a considerable portion is converted into non-crystallisable sugar. Here is some beet-root juice which has been standing for some time in a bottle, and whereas in its natural state it flows freely, you see now it has become slimy and thick. Beet-root juice very readily passes into this state of fermentation, and, as it is difficult to use a pump without leaving behind in different parts of the apparatus a small quantity of the juice or of the pulp which is carried with it, and which soon gets into this sticky, slimy state, the operation of raising the juice to the iron cisterns is performed by an apparatus called a juice-lifter, of which I have here sketched a rough diagram. It consists of a wrought-iron cylinder, from the bottom of which proceeds a pipe leading to the cistern at the top of the building, whilst a branch from the same pipe communicates with the reservoir of juice to be lifted. The top of the cylinder has two openings, one communicating with the external air, and the other with a steam boiler. On opening the cock communicating with the air, and also the one communicating with the juice to be lifted, the iron cylinder is soon filled with the juice. These two cocks are then shut off, communication is made with the cistern to which it has to be lifted, and, at the same time, steam is allowed to enter from the steam boiler, and the pressure of the steam soon forces the whole of the juice in the cylinder into the cistern above. This apparatus, therefore, has the double advantage that none of the juice is left behind, and at each operation the vessel is thoroughly cleansed and scalded out by the action of the steam.

(To be continued).

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Monday, January 15th, 1872.

Dr. William Wallace, F.R.S.E., President, in the Chair.

Mr. James Mactear, read a paper entitled "*Notes on the Loss of Soda in Leblanc's Process.*"

The author first gave an outline of the process and of the reactions which occur in the various stages of the operation so far as they are known, and he favourably noticed, in passing, the results of the experimental investigations made by Mr. Gossage, of Widnes, and those of Mr. Kolb, the manager of Messrs. Kuhlman's alkali works. In addition to the general reactions there are many of a minor character, owing to impurities in the raw materials. Some of these impurities only occur in traces, but in several instances they affect the results. One instance was given by the author which is of a very interesting character: it is the fact of tribasic phosphate of soda occurring in the highly concentrated mother-liquors, from which it separates in fine ruby-coloured crystals, the colour of which is due to the presence of traces of a vanadium salt. The author dwelt at some length upon the proper method of taking samples of the materials used and the products obtained, and on the general mode in which the experiments should be conducted.

The sources of loss in the soda process were stated by the author in the following way:—

I. *Loss in the sulphate manufacture.*
   1. As undecomposed salt.
   2. As loss in the process.

II. *Loss in converting the sulphate.*
   1. As undecomposed sulphate.
   2. As sulphide, sulphite, hyposulphite, &c.
   3. Volatilised and lost mechanically.
   4. Lost in the water, partly as insoluble and partly as soluble compounds.
   5. By secondary decomposition, as in the exposure of the ball soda to air and moisture, and the formation of sulphites, &c., and in the tanks, by the water being too hot or the digestion too much prolonged, and the consequent formation of sulphide of sodium.
   6. By the presence of iron, and the formation of double sulphate of iron and sodium.

Under these divisions and sub-divisions the author treated the subject. He stated that the loss as undecomposed salt is, in most well-conducted works, never over 2½ per cent, while in many it is under 2 per cent and he considered it questionable if it would pay to reduce this loss much further, inasmuch as there is a danger of some sulphuric acid being driven off with the hydrochloric acid, and thus a large amount of it would be required for the decomposition of the remaining 2 per cent. The loss in the process of converting the common salt into sulphate had been found to vary from 1 per cent to 0·05 per cent, and it is certainly not more than 0·5 per cent on the average, if it is even so much. The loss, as undecomposed sulphate, in the process of converting to carbonate was found, in a prolonged series of testings, to be on the average 1·53 per cent of the crude sulphate, showing that 98·47 per cent was rendered available. This loss is set down by Wright, in his paper read before the Chemical Society, at 3·49 per cent, while Hargreaves makes it about 2 per cent. In the case of well made bell-soda the loss in the form of sulphide is comparatively small, but otherwise there is often a considerable quantity of sulphide of sodium formed. The author finds it difficult to arrive at reliable results in respect of the loss as sulphide, sulphite, hyposulphite, &c., previous to the lixiviation, and he therefore classes it with the loss during lixiviation. There is but little, if any, loss by volatilisation, and in well-constructed furnaces, and such as are provided with carefully-worked check dampers, there need be but little material lost mechanically. The substance lost in the shape of flue dust occurs as common salt to a minimum amount, also as carbonate of soda, but chiefly as sulphate. In one instance where no check damper was used, the flue dust consisted of 60 per cent of sulphate of soda.

The chief loss in the soda process is that which occurs during the lixiviation of the ball-soda. This loss is in part represented by the insoluble and soluble compounds left in the waste. The former sometimes amounts to 3 or 4 per cent of the soda, and the amount is increased as the silica and alumina of the raw materials increase. It varied from 2·20 per cent to about 3 per cent of the soda represented by the original salt in the experiments made by the author. The actual loss from soluble salts left in the waste is usually equal to from 2 to 3 per cent on the original started with. Curiously enough, the oxidised alkali waste yields, on lixiviation, almost the whole of the soda contained in the waste. It occurs in the solution as sulphate. In one sample of this liquor there was as much as 920 grains of sulphate per gallon, and when the liquor was used to lixiviate a second quantity of the oxidised waste, the sulphate rose to 2700 grains per gallon. The loss by secondary decomposition is due, in a great measure, to the formation, in the first instance, of sulphite, hyposulphite, and sulphate of lime, which, in presence of carbonate of soda in solution, are converted into the corresponding soda salts. Under certain circumstances this action goes on very rapidly. The amount of sulphate formed in this way is seldom large, but the sulphite and hyposulphite together have been found to amount to 0·704 per cent of the original soda. The chief source of the loss from this secondary decomposition is in the formation of sulphide of sodium. This compound is almost entirely wanting in well made ball-soda, but it is readily formed from the decomposition of the sulphide of calcium in the tanks. The author's results, in respect of the loss by sulphide of sodium, give an average of 2·68 per cent on the original soda.

The author proceeded to summarise the results of manufacturing operations carried on over a series of years, choosing first an establishment on the Tyne where the production is considered good, and where the salt decomposed is about 26,000 tons per annum. The observations extended over a term of seven years, with the following results:—

100 parts yielded—		
Available soda		84·54
Loss as neutral salts	7·26	
Loss in process	8·20	
		15·46
		100·00

In this instance the impurities, in the shape of chlorides, in the Tyne water interfered with the economy of the process to a very sensible extent, the loss in this way being from 5 to 6 cwts. as common salt per day.

An actual experiment with the work of one furnace being made—

100 parts yielded—		
Available soda		86·93
Loss as neutral salts	5·30	
,, in waste	6·96	
,, mechanically, &c.	0·81	
		13·07
		100·00

Taking the loss as neutral salts and in the waste together, there was totally lost in this experiment 7·77 per cent of the available soda.

Another actual experiment was most carefully performed, and under favourable circumstances, with the following results:—

100 parts yielded—			
Available soda			89·87
Loss as sulphide of sodium	2·81		
,, as other neutral salts	1·65		
		4·46	
,, in waste, insoluble	2·20		
,, ,, soluble ..	2·20		
		4·40	
,, in experiment		1·27	
			10·13
			100·00

In an actual experiment embracing one years' work, there were the following results:—100 parts of common salt gave 86·318 parts of ash of 48 per cent strength:—

100 parts yielded—			
Available alkali			85·91
Loss as neutral salts—			
Sulphate of soda ..	5·22		
Common salt	2·90		
		8·12	
Loss in waste, &c. ..		5·97	
			14·09
			100·00

Leaving out of consideration the results obtained in the Tyne establishment, on account of the character of the water used, and those of the actual experiment referred to in the third table, inasmuch as it was an experiment performed on a small scale, the results are remarkably near each other, the average loss being as—

Neutral salts	7·09
Total loss	6·36
Loss in process	13·45

If the number of operations in the process, and the various complicated reactions which are involved, be considered, this loss can scarcely be deemed excessive, the actual total loss being under 7 per cent, the remainder of that being due to neutral salts existing in the product. These results, when compared with those of Wright, show a much smaller loss, about 6 per cent; but the fact that his sulphate contained 5·31 per cent of undecomposed salt is sufficient to show that the working was defective and the loss much higher than it should be. It would also seem as if the materials were very impure, as the insoluble soda is given by Wright as 5·44 per cent, an amount which the author considered exceptionally high. He also considered that there was room for improvement in the process, especially in the lixiviating operation, where the loss in sulphide takes place. A modified system of tanks and a good method of testing the liquors are the best means of checking the formation of this compound. Hargreaves gives six instances in which the loss varies between 10·72 and 20·65 per cent, the average being 16·49 per cent. Against this average the author gave from his approximate production book a loss of 11·5 per cent.

A short discussion followed, and several questions were put to Mr. Mactear, to which he replied.

CORRESPONDENCE.

THE FOREIGN DEGREE TRADE.

To the Editor of the Chemical News.

Sir,—The publication of the subjoined correspondence may possibly do something towards stopping the disgraceful traffic in academical degrees, to be granted *in absentia*, of which those who have really worked for the honours that have been awarded to them have so much cause to complain.—I am, &c.,

E. D. H.

An advertisement having been extensively published offering degrees *in absentia* upon application to "Medicus," 46, King Street, Jersey, I requested a friend to send the following letter:—

"Dear Sir,—Observing that you generously offer instructions for proceeding to degrees in foreign universities *in absentia*, I should esteem it a favour if you would let me know from what university a degree (not medical, nor clerical) could be obtained, and what would be about the cost.—Yours faithfully, ——; Sept. 26, 1871."

This business-like enquiry elicited the following equally business-like reply:—

"Dear Sir,—I shall be most happy to give you the benefit of my influence and assistance in obtaining for you a learned degree: as you, however, do not inform me your profession or occupation, I cannot very well judge what degree is most suitable. The degree would be granted by the American University of Philadelphia, one of the leading colleges in the United States. I undertake all the formalities at my own risk and expense; you would obtain the diploma *in absentia*, and without trouble or removing yourself. I could influence you one of the following degrees:—

Ph.D—Doctor of Physiology.
Ph.D.—Doctor of Philosophie (*sic*).
M.A.—Master of Arts.
B.A.—Bachelor of Arts.
Mus. D.—Doctor of Music.
D.C.L.—Bachelor (*sic*) of Civil Law.
LL.D.—Doctor of Laws.
Litt. Hum. D.—Litteræ Humaniores Doctor.

Therefore you may elect what you like best and let me know. The fees of the faculty, including the granting of degree, the cost of diploma, the signing by the professors, and passing collegical seal and registration dues amount exactly to £20, beyond which nothing is to be paid.—Waiting your reply at your earliest convenience, I remain, dear Sir, yours faithfully, P. F. A. V——.; Sept. 29."

On receipt of this letter I at once put myself in communication with the Provost of the University of Pennsylvania, who favoured me with extracts from the statutes of the University relating to the granting of honorary degrees (the regulations are quite as stringent as those of Oxford and Cambridge), and with an extract from the Act of the State of Pennsylvania, making "the payment, or promise of payment," by any person for an academic degree, or the signing of a diploma conferring a degree, under such circumstances a misdemeanor punishable by a fine not exceeding 500 dollars and six months' imprisonment, or both, or either, at the discretion of the Court.

On the day following the receipt of the above from Dr. Stillé, our Jersey friend favoured us with the following:—

"Dear Sir,—Shall be glad to be informed which degree you prefer; there are several to be had as Doctor of Philosophy, Doctor of Music, Doctor of Sciences, Master of Art, Bachelor of Art, &c., &c., all of which I can obtain for you *in absentia*. Give me anyhow a reply, as I am making up a list of candidates which are desirous to be nominated before Christmas.—Yours faithfully, P. F. A. V——., LL.D.; 46, King Street, Jersey."

To this I, through my friend, replied thus:—

"Dear Sir,—I was so struck with the price of all degrees being similar, having been accustomed to estimate gold and brass at different rates per pound, that I decided to write to an American friend before taking any further steps. As I observe from your notes that you are neither an Englishman nor an American, you will excuse me for informing you that "who," not "which," is, as a rule, applied to *persons*.—Yours faithfully, ——."

Believing the University of Pennsylvania to be, as it certainly is, far above selling its honours, I sent a copy of the above correspondence to Dr. Stillé, congratulated him on the energy of his European representative, and asking him for an official repudiation of the Jersey LL.D. (*sic*), and I have just received from him the subjoined letter. He appears to have taken mine more seriously than I had intended.

"Provost's Room,
"University of Pennsylvania,
"Philadelphia, Dec. 29, 1871.

"Dear Sir,—I am greatly surprised to find by your letter of December 11th that, after all my efforts to enlighten you on the subject, you are still in the dark as to the position of this University towards the fraudulent traffic in academic degrees which is now carried on in England. Need I repeat to you that this University has not, as you suppose, any 'representative' in England, and that no respectable college or university in this country would ever employ agents anywhere to recommend candidates for degrees or receive fees under any pretext when those degrees are bestowed. The rules among decent people here on this subject are quite as strict as at Oxford or Cambridge; indeed, they are stricter, for, according to our statute law, any person signing a diploma which has been paid for is liable to fine and imprisonment, and, besides, the degree purporting to be conveyed is absolutely invalid. You have probably been misled by supposing that, according to the European practice, there can be here but one university in one city. But the only application of the doctrine of 'free trade' which we have here is in the matter of education. The freest competition is allowed; and hence we have not only here this University (which is one of the oldest and best known in America, having been founded by the great Dr. Franklin in 1750), but also 'The Philadelphia University of Medicine and Surgery' and 'The American University of Philadelphia.' You will see at once that these titles are colourable (as the lawyers would say) imitations of our own. You will, of course, now understand that we are in no way responsible for their fraudulent practices, and can only, with all honest people, condemn them. If Englishmen wish to receive honorary degrees from colleges or universities in this country of the slightest reputation you will, perhaps, permit me to say that they must pay no fees under any pretext for such honours, and above all must have nothing to do with people calling themselves agents for the sale of degrees. I shall be greatly obliged if you would give this note as wide a publicity as possible. If the facts were generally known, a part of my English correspondence, which is very disagreeable and very laborious, might be given up.—Very respectfully, C. J. Stille, Provost Univ. Penn."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 1, 1872.

This number contains the following original papers and memoirs:—

Presence of Pyrocatechin in Kino.—F. A. Flückiger.—After briefly referring to Dr. von Gorup-Besanez's discovery of pyrocatechin as met with in a living plant, and the opinion expressed by that *savant* respecting the probable origin of pyrocatechin in kino (see Chemical News, vol. xxiv., p. 300), the author relates at length a series of researches made with several different samples of kino (presented to him by Mr. D. Hanbury, F.R.S., of London, all these samples being of well authenticated origin), in all of which pyrocatechin is present, the same substance being also found in the Australian *Eucalyptus* gum. From these facts the author draws the conclusion that the pyrocatechin present in the substances alluded to is due to its presence in the living plants from which these materials are extracted.

Decomposition of Sulpho-Bromide of Phosphorus by Water and Alcohol.—A. Michaelis.—The author refers first to his former paper on this subject (see Chemical News, vol. xxiv., p. 217), and next states that the sulpho-bromide of phosphorus is decomposed by alcohol simply in the manner that the bromine is exchanged for ethoxyl, giving rise to the formation of mono-sulpho-phosphoric-acid-ethyl, $PS.3(OC_2H_5)$, a body already prepared and described by Dr. Carius ("Beitrag zur Theorie der Mehrbasischen Säuren," von Dr. L. Carius, p. 10). By a quantitative experiment, made to ascertain the products of the decomposition of sulpho-bromide of phosphorus under the influence of water at 100° in a sealed tube, the author obtained—Free sulphur, 7·59 per cent; phosphorus, 2·81; phosphorous acid and sulphur, together, 71·99; sulphuretted hydrogen and phosphoric acid, together, 28·01.

Sulpho-Bromo-Chloride of Phosphorus.—A. Michaelis.—By a rather circuitous and complicated process, starting with mercaptan and chloride of phosphorus, the author obtained ethyl-sulpho-phosphoric-acid-chloride, $PCl_2.(SC_2H_5)$, a colourless fluid, boiling at from 172° to 175°; sp. gr. at 12° = 1·30; it is decomposed by water into hydrochloric and phosphorous acids and mercaptan. Along with this compound the author obtained sulpho-phosphorous-acid-ether, $P(SC_2H_5)_3$, a colourless disagreeably-smelling fluid, boiling with partial decomposition at between 240° and 280°; sp. gr. at 12° = 1·24; water gradually converts it into phosphorous acid and mercaptan. In order to prepare sulpho-bromo-chloride of phosphorus, the author treated 1 molecule of $PCl_2.(SC_2H_5)$ with 1 molecule of bromine; the result of this operation (attended with difficulties, and a tedious process of purifying) is the formation of the body already mentioned, a faintly yellow-coloured fluid, exhibiting a pungent aromatic odour, boiling at 159° with partial decomposition, not acted upon by water even at 100°, but decomposed by that fluid at 150° in a sealed tube. The formation of this compound may be elucidated by the following formula:—

$$PCl_2.(SC_2H_5)+Br_2=PCl_2.(SBr)+BrC_2H_5.$$

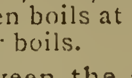
Bromo-Chloride of Phosphorus.—A. Michaelis.—In the first portion of this paper the author refers at some length to Dr. Wichelhaus's investigations on this subject (*Ann. d. Chem. u. Pharm.*, suppl. bd. 6, p. 277), and next states that bromo-chloride of phosphorus is a yellow-red coloured solid mass, which becomes dissociated into chloride of phosphorus and bromine at 35°, but below that temperature the body is immediately re-constituted; in contact with water and acids it is decomposed in the following manner:—

$$3PCl_3Br_2+3(OH_2)=2POCl_3+POBr_3+3ClH+3BrH.$$

Action of Penta-Chloride of Phosphorus upon Nitro-Naphthaline.—L. de Koninck and P. Marquart.—After observing that Dr. Oppenheim stated some years ago that the chlorides of phosphorus do not act upon the various nitro-derivatives, the authors record a series of experiments just made by them the result of which is that when PCl_5 is heated (this operation requires caution when larger quantities of the substances are experimented with, owing to the very violent reaction then ensuing) along with nitro-naphthaline there is formed chloride of naphthaline, according to the following formula:—$C_{10}H_7NO_2+PCl_5=C_{10}H_7Cl+POCl_3+NOCl$; the chloride of naphthaline resulting from this reaction is in every respect identical with the body obtained by Faust and Saame (see *Ann. d. Chem. u. Pharm.*, bd. clx., p. 68). The chloride boils at between 251° and 255°; sp. gr. at 15° = 1·2025. PCl_5 does not act upon the rhombic modification of dinitro-naphthaline; nitro-benzol boiled along with PCl_5 does not yield chloride of benzol.

Carbazol.—C. Graebe and C. Glaser.—The authors relate at length how, by the process of purification of crude anthracen, they discovered, under conditions to be afterwards communicated, the body (carbazol) $C_{12}H_9N$, a solid substance, which, notwithstanding that it contains N, exhibits the general characters of a hydrocarbon; it crystallises, is insoluble in water, but soluble by the aid of heat in ether, alcohol, and benzol; it fuses at 238°, boils at 338°, is not decomposed at red heat, nor affected at that temperature by the contact of zinc-dust and soda-lime. Carbazol is soluble without decomposition in strong sulphuric acid; it is not decomposed by fusing caustic potassa, neither by a boiling concentrated aqueous solution of that alkali, but oxidising substances attack carbazol violently. With chlorine and bromine, substitution compounds are formed; with picric acid it forms a beautifully red-coloured crystalline body, $C_{12}H_9N,C_6H_2(NO_2)_3OH$. When carbazol is heated for some hours in a sealed tube to from 200° to 230°, along with a mixture of ½ part of amorphous phosphorus and 4 parts of hydriodic acid (boiling-point, 127°), there is formed carbazoline, $C_{12}H_{15}N$, a solid substance, readily soluble in alcohol, ether, and benzol, fusing at 96°, boiling at 286°, and yielding, with acids, salts which are readily soluble in water.

Vapour Densities of some Organic Substances having a High Boiling-Point.—C. Graebe.—The author describes at length a series of experiments on vapour density estimation of the following substances:—Anthrachinon; vapour density found by experiment, 7·33; the formula, $C_{14}H_8O_2$, requires 7·20. Pyren, $C_{16}H_{10}$: found, 7·2; theory, 7·0. Acenaphten, $C_{12}H_{10}$; found, 5·35; theory, 5·33. Phthalic-acid-anhydride; found, 5·32; the formula—



$$C_6H_4\begin{matrix}CO\\CO\end{matrix}$$

requires 5·12. Acridine; found, 6·10; theory, 5·85. Chrysen; experiments did not succeed; chrysen boils at a temperature very nearly the same as that at which sulphur boils.

Relations Existing between the Crystalline Form and the Composition of the Native Compounds of Tantalum and Niobium.—Dr. C. Rammelsberg.—The contents of this essay, full of a large number of complex formulæ, are not suited for abstraction.

Nonylic Acid from the Octyl-Alcohol of the Heracleum Oil.—A. Franchimont and Th. Zincke.—In the first portion of this paper the authors refer to their former researches on this subject (see Chemical News, vol. xxiv., p. 263), and next state that they have, by treating the octyl-alcohol so as to form a cyanide, and next saponifying that body with alcoholic potassa solution, obtained an acid containing 9 atoms of carbon, which acid, separated from its potassa salt, has been termed by them nonylic acid, a colourless, oily fluid, which becomes solid at below + 10°, and boils at from 253° to 254°; sp. gr. at 17° = 0·9065; it is very slightly soluble in water. In addition to the methylic and ethylic ethers which this acid forms, the authors describe the potassa, soda, ammonia, baryta, lime, copper, cadmium, zinc, and lead salts of this acid. The formula of the ethylic ether is $C_9H_{17}O(C_2H_5)O$; that of the baryta salt is $(C_9H_{17}O_2)_2Ba$.

Tri-Amido-Benzol.—H. Salkowski.—In the first portion of this paper, elucidated by a series of formulæ, the author enters into a series of theoretical discussions, and next describes at great length the mode of preparation of tri-amido-benzol quite free from any tri-amido-phenol. The former of these two bodies (formula, $C_6H_3(NH_2)_3$) is a solid, deep red, crystalline substance; it fuses at between 103° and 104°, boils at 300°, and is readily soluble in water, alcohol, and ether. The concentrated aqueous solution exhibits an alkaline reaction, and yields with chloride of iron solution a precipitate, at first deep violet-coloured, afterwards brownish coloured. Treated with concentrated sulphuric acid containing a trace of nitric acid, tri-amido-benzol yields a deep blue colouration, which disappears by the addition of water. Hydrochlorate of tri-amido-benzol, $C_6H_3(NH_2)_3,2HCl$, is a crystalline salt, as is also the sulphate.

Combinations of the Aldehydes with Phenols.—A. Baeyer.—This lengthy essay is divided into the following sections:—Oil of bitter almonds; aldehyde; furfurol.

There is added to this number, as appendix, a list containing the names and addresses of the Fellows of this society. Any change of address is requested to be immediately reported to the publisher of the *Berichte*, Herr Ferd. Dümmler, 86, Wilhelmstrasse, zu Berlin.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 226, October, 1871.

This number does not contain any original papers relating to chemistry.

Journal de Pharmacie et de Chimie, December, 1871.

This number contains the following original papers and memoirs:—

On a Urine Containing a Violet-Coloured Sediment.—C. Méhu.—After first referring to the pathological conditions of the system which can affect the composition of urine, and also to Dr. E. Schunck's researches ("On the Occurrence of Indigo in Urine," *London, Edinburgh, and Dublin Philosophical Magazine*, 4th series, 1867, vol. xiv., p. 288), the author relates at great length the researches made by him on a urine which was found to contain a violet-coloured sediment. This urine exhibited a very alkaline reaction, contained some albumen, had a fœtid odour (when fresh), and became spontaneously red-coloured by exposure to air. By further research the author was enabled to extract from the sediment a red-coloured matter, insoluble in water, soluble in ammonia, alcohol, and ether. A blue substance was also obtained, and found to be insoluble in water, and difficultly soluble in chloroform and ether; this substance dissolves in strong sulphuric acid; the solution has a great resemblance to that of indigo in the same solvent, and, like the latter substance, is decolourised by chlorine and nitrous acid vapour; this blue pigment was obtained from urine in the state of crystals from a boiling alcoholic solution.

Preparation of Crystallised Indigotine by means of Phenic Acid.—C. Méhu.—The author begins by making the observation that, in works on chemistry, indigotine is described as a body insoluble in water, alcohol, ether, fatty and essential oils, and dilute acids and alkalies; yet strong and boiling alcohol, and even somewhat more so methylic alcohol (not methylated spirit), dissolve enough indigotine to become blue-coloured, but, on cooling, the greater part of the dissolved substance is thrown down again. By experimenting with phenic acid, the author has found that this substance is an excellent solvent for indigotine, which may be extracted readily and in pure state from indigo, care being taken to wash this latter substance first with water, then with dilute hydrochloric acid, and next several times with boiling hot alcohol; in order to prevent the solidification of phenic acid on cooling (heat has to be applied to dissolve the indigotine), some camphor may be added to it. With 500 grms. of phenic acid, 2 grms. of indigotine may be readily obtained in one operation, and in very pure well-defined crystals. Indigotine is also soluble, to some extent, in phenic acid when cold, this solution exhibiting a very deep purple colour.

Some of the Inconveniences Arising from the Substitution of Soda for Potassa.—P. Carles.—Among the instances brought forward by the author we quote the following:—When iodide of potassium is made with potassa which contains soda there ensues, by the calcination, a considerable loss of iodine; moreover, iodide of sodium renders iodide of potassium deliquescent in the air. When potassa contains soda it is less suitable for use in Liebig's bulbs, because the carbonate of soda which is formed by the action of the carbonic acid takes up water, and thereby renders the alkaline ley turbid, and may even so thicken the liquid as to stop the passage of the gas altogether. As regards the silicates of potassa and soda, the author observes that, although their physical properties are very similar to each other, silicate of soda cannot, in all respects, be used as well as that of potassa.

Reports on the Manufacture of Benzol, Nitro-Benzol, Aniline, and Fuchsine.—Dr. Vigla.—The author gives in this paper an excellent abstract of the labours of the Conseil d'Hygiène Publique et de Salubrité de la Seine on the proper precautions to be observed in conducting the manufacture and disposing of the waste products of the substances alluded to.

Instruction concerning the Precautions to be Taken when Repairs have to be Done to the Leaden Chambers of Sulphuric Acid Works.—Dr. Bontron.—This excellent paper contains a detailed account of the proper mode of managing the arrangements which have to be made when sulphuric acid chambers have to be repaired, so that accidents due to too great hurry in entering th chambers are prevented.

Archives Neérlandaises des Sciences Exactes et Naturelles Publiées par la Société Hollandaise des Sciences à Harlem, Vol. vi., No. 4, 1871.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Meteorite of Tjabé, Netherlands' India.—Dr. E. H. von Baumhauer.—This memoir contains, in the first place, a well authenticated account of the several phenomena which accompanied the fall of the meteorite just alluded to on the evening of Sept. 19, 1869. Nine hours after the fall of this stone it was yet so hot that it could not be touched by the hands; the weight of the mass amounted to some 20 kilos.; sp. gr. of this material, 3·456; separable by magnet, 14 per cent; sp. gr. of this portion at 15° = 6·8; relative proportion of nickel to iron in this part of the meteorite, 1 : 15. Composition of the silicated portion, in 100 parts—Insoluble in HCl, 50·14; sulphuret of iron, 3·71; silicic acid, 15·95; magnesia, 16·40; protoxide of iron, 12·01; lime, 0·74; soda, with a trace of potassa, 0·32; alumina, 0·22; protoxide of manganese, 0·30; protoxide of nickel, a trace. This exhaustive memoir also contains a series of observations on the methods of analysis of meteorites, and a comparative review between the composition of this stone and others fallen in Europe and analysed by other *savants*.

Relation Existing between the Rotatory Polarisation Power of Organic Bodies.—F. W. Krecke.—We regret that we can only quote here the headings of the different sections of this very lengthy monograph—Laws of rotatory polarisation; application of the laws of rotatory polarisation; carbohydrates, glucoses, saccharoids, sugars not capable of undergoing fermentation; other carbohydrates; glucosides; hydrocarbons and camphors; acids; alcohols; alkaloids of cinchona, strychnos, opium; constituents of bile; albuminoid substances. From the author's exhaustive and very carefully made researches, he deduces, as regards the molecular rotatory power of the different carbonated bodies *(corps carbonés)*, the following laws:—When an optically active body enters into combination with an optically inactive substance, or when the optically active body is modified by chemical reagents, the molecular rotatory power remains either unaltered or is altered in such a manner that the molecular rotatory power of the new body is a simple multiple of that of the generating body *(corps générateur)*; isomeric bodies possess molecular rotatory powers which are simple multiples of a same number.

Vol. vi., No. 5, 1871.

This number contains the following original memoirs and papers relating to chemistry and collateral sciences:—

Observations on the Microscopical Structure of the Cinchona Barks.—Dr. C. A. J. A. Oudemans.—This essay is a valuable contribution to our knowledge of the cinchona barks in general, and more especially those grown in Java.

Hygrometry at the Meteorological Observatories.—Dr. E. H. von Baumhauer.—The description, illustrated by engravings, of an instrument devised by the author, and termed an areometric hygrometer, by means of which the atmospheric moisture can be estimated exactly, and is recorded automatically and continuously.

Researches on the Origin and Chemical Constitution of the Terpèn Resins (Resins Proper).—A. P. N. Franchimont.—This exhaustive monograph treats, in the first place, on the mode of formation of the resins in plants; and, next, at very great length, on the chemical constitution of the resins. It is, however, impossible to enter here into further details, owing to the fact that this subject (treated *à main de maître*) is illustrated by several engraved plates.

Empiricism and Science: Historical Essay on Lavoisier.—Dr. J. W. Gunning.—A very interesting, valuable, and highly unprejudiced account of the real value of Lavoisier's knowledge and labours.

Bulletin de l'Academie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, Nos. 9 and 10 (double number), 1871.

This number does not contain any original papers relating to chemistry.

American Journal of Pharmacy, January, 1872.

In addition to several very interesting original papers strictly relating to pharmacy, this number contains the following original chemical paper:—

Litmus-Paper as a Reagent.—C. Bullock.—This paper contains the results of a few experiments made by the author to solve approximatively the question, "What amount of acids or alkalies is necessary to give a distinct change of colour to the test-paper?" Blue litmus-paper should be distinctly blue, but not a deep shade, in colour; the directions given by Dr. Fresenius in his "Qualitative Analysis" will afford a sensitive paper. When carefully made it affords the reaction with one drop of acetic acid at 30 per cent in the following quantities of water:—In 4 ozs., it turns red immediately; in 6 ozs., completely red in half a minute; in 10 ozs., changes on the edge in one-fourth minute, and is completely reddened in 1 minute; in 13 ozs., it is completely red in 1½ minutes, and remains red when dry; in 16 ozs. of water the limit of distinct reaction is found. Reddened litmus should have a purple-red colour, and the paper when dry a distinct red colour free from blue. With 1 grain of anhydrous carbonate of soda in 32 ozs. of water the paper turns blue in 1 minute; in 56 ozs. in 3 minutes in 64 ozs. in 4 minutes; in 80 ozs. in 7 minutes; in

160 ozs. of water the limit of distinct reaction is found; the blue shade can be seen before the colour is dissolved from the paper. In these experiments the paper was submerged in the liquid.

Les Mondes, January 18, 1872.

New Physical Law.—A. Valson.—From the researches made by the author, he concludes the following is a new law in physics:—For all normal solutions—that is to say, those which contain each 1 equivalent of anhydrous salt, weighed in grammes, dissolved in 1 litre of water—the product of the density by the capillary height is perceptibly the same.

Autographic Telegraph Apparatus.—M. d'Arlincourt.—This paper contains a detailed account of the description and mode of manipulating a kind of apparatus which has been tried in France on a telegraphic line of which the two termini are 900 kilometres distant from each other; the velocity of transmission is the same as Hughes's apparatus (forty dispatches per hour); the results are said to be satisfactory in all respects.

Newly-Contrived Apparatus for Utilising the Force of the Wind.—M. Duros de Hauron.—A lengthy description, illustrated by engravings, of an apparatus which may be better than the construction of our well-known wind-mills.

January 25, 1872.

Oxyhydrogen Light.—Rev. F. Moigno.—From the few particulars communicated in this paper we quote that, by the use of a gas-burner consuming 32 litres (1·13014 English cubic feet) per hour of the coal-gas as supplied in Paris, and burnt by the aid of 16 litres of oxygen, there is produced a light equal to that of the Paris standard burner, consuming 140 litres of coal-gas per hour, while, with the aid of oxygen, the combustion is quite complete, and very much less heat generated; it is further stated that this process is 20 per cent cheaper than ordinary gas-lighting.

Improved Lamp-Glass for Moderator and Paraffin-Oil-Burning Lamps.—M. Lallemand.—In glasses of the ordinary shape and size are bored a number of very small holes, which cause jets of air to play upon the flame in such a manner as to accelerate, as well as render more complete, the combustion, while, at the same time, the glass is kept quite cool comparatively to those in ordinary use; there is also a far better and stronger light for the same consumption of oil.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, December 14, 1871.

Researches on the Fats of some of our Domestic Animals.—C. Mène.—The author gives us here, in tabulated form, the results of his very extensive researches on the specific gravity and points of solidification and of fusion of the fats of different races of bullocks, cows, sheep, pigs, calves, and lambs, and also compares his results with those obtained by other scientific chemists of older and of more recent date.

La Revue des Scientifique de la France et de l'Etranger, January 6, 1872.

This number does not contain any original papers relating to chemistry.

NOTES AND QUERIES.

Canadol.—(Reply to R. F.).—See Chemical News, vol. xxiv., pp. 145, 168. Canada oil is nothing else than highly rectified benzoline or petroleum spirit.

Induction Coil.—I have a battery of 50 Bunsens; zincs 5×3, carbons $6\times1\frac{1}{8}\times1\frac{1}{8}$. How long ought the primary wire of an induction coil be, so that I can use my battery with it without fear of heating the coil and consequently making it useless, and also the No. of the thickness of the wire?—S. C. J.

Softening Water by means of Lime.—(Reply to W. R.)—The periodical you name is published at Augsburg, by the well-known firm of J. G. Cotta; any foreign bookseller will give you the information you ask for. As regards the second part of your question, you are referred to the original German paper you mention; of course the composition of the solid matter dissolved in the water will have to be studied.

Stannate of Soda.—(Reply to C.).—This salt is very frequently made by the dyers themselves according to receipts which answer their purpose best; its value depends chiefly upon the quantity of tin it contains. This salt is frequently met with adulterated with common salt; ordinary good amorphous stannate contains from 25 to 30 per cent of water. The price of this salt you will find quoted in drysalters' price-lists.

Asbestos Cloth—Loss of Mercury.—Could you inform me where "asbestos cloth," a material used for making firemens' clothes, is procurable: at least, I believe it was suggested for the mentioned purpose. At the same time, do you know if it is a known fact that metallic mercury dissolves in pure sodic chloride? I am interested in the last particular very much, as I have *found* it to be. There is a loss of mercury in the American amalgamation process of obtaining silver by conversion into $HgCl_2$, but I think it is owing to—

$$Hg+2AgCl=HgCl_2+Ag_2$$

only. Could you supply me with the desired information I should be extremely obliged.—C. T. Kingzett.

MEETINGS FOR THE WEEK.

Monday, Feb. 5th.—Royal Institution, 2. General Monthly Meeting.
— London Institution, 4. Prof. Odling, F.R.S., on "Elementary Chemistry."
— Anthropological, 8. Anniversary.
Tuesday, 6th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
— Civil Engineers, 8.
— Zoological, 9.
Wednesday, 7th.—Society of Arts, 8.
— Geological, 8.
— Microscopical, 8. Anniversary.
— Pharmaceutical, 8.
Thursday, 8th.—Royal, 8.30.
— Royal Society Club, 6.
— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
— London Institution, 7.30.
Friday, 9th.—Royal Institution, 9. Prof. Humphry, F.R.S, "On Sleep."
— Quekett Microscopical Club, 8.
— Astronomical, 8. Anniversary.
Saturday, 10th.—Royal Institution, 3. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

TO CORRESPONDENTS.

⁂ Vol. XXIV. of The Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxv. commenced on January 5th, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

Tyro.—Only take a small piece of phosphorus; heat gradually, and to prevent absorption, put on a small Welter's safety-tube.

T. Hale.—You had better advertise for the information.

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THE
MANUFACTURE OF CHLORINE.

ALTHOUGH the development of the process for the Manufacture of Chlorine by means of oxides of manganese regenerated by means of magnesia, to which reference was made on this page some months ago, has been sorely delayed by serious ill-health on my part, I am nevertheless in a position to announce that that process, in a certain modified form which it has now assumed, has proved capable of yielding even more advantageous results than I formerly claimed for it. It will necessarily be yet some time before I can be able or free to supply working details. Meanwhile, I beg to report as follows :—

I. That the new form of process yields, in the free state, practically *all* the chlorine contained in the salt decomposed, being at about the rate of *a ton of bleaching-powder per fourteen hundredweights of salt.*

II. That, of the chlorine which it thus yields, a sufficient proportion to give a ton of bleaching-powder for about each thirty hundredweights of salt is ENTIRELY UNDILUTED, and therefore available for the manufacture of bleaching-powder in the chambers at present in use. This portion of the chlorine is generated in the ordinary (Weldon) stills, and is in precisely the same condition as that produced in my process as at present practised, or as that generated by means of native manganese.

III. That, while the remainder of the chlorine is *dilute*, it is not more so than that produced in any process yielding dilute chlorine only, and is free from carbonic acid, the sole diluent being nitrogen.

IV. That the process, in its new shape, is performed without blowing engines, and *without machinery of any kind*, by appliances already in use in every alkali-work, the only thing employed in it which has any "moving parts" being an ordinary liquor-pump.

The new form of process thus yields more *strong* chlorine, per given quantity of salt, than has ever hitherto been produced by any process whatever, and, in addition, yields the remainder of the chlorine in as good a state as the richest chlorine producible by any process which yields dilute chlorine only. While permitting the present production of bleaching-powder, per given quantity of salt, to be nearly *quadrupled*, it enables one-half of the quadrupled production to be made from undiluted chlorine, in such chambers as have been employed hitherto, and one-half of the chlorine to be generated in the present stills. Putting the whole cost of the process on the *strong* chlorine only, the cost of the latter, per ton of bleaching-powder, promises to be lower than it has ever been yet, the other half of the chlorine counting as not costing at all. Lastly, the special plant required for the new form of process is so simple and inexpensive, that the cost of a plant for any considerable production will probably not exceed £20 for each ton of bleaching-powder to be made by it per week.

WALTER WELDON.

Offices of WELDON'S CHLORINE PROCESSES COMPANY, (Limited),
59, Lincoln's Inn Fields, London, W.C.

December 12th, 1871.

THE CHEMICAL NEWS.

Vol. XXV. No. 637.

ON THE ELIMINATION OF ALCOHOL.*

By A. DUPRE, Ph.D.,
Lecturer on Chemistry at Westminster Hospital.

Obviously three results may follow the ingestion of alcohol. All the alcohol may be oxidised and none be eliminated; or a portion only may be oxidised, and the rest be eliminated unaltered; or, lastly, all may be eliminated again unaltered. Assuming the last to be the case, it would follow that if a certain quantity of alcohol be taken daily, the amount eliminated would increase from day to day until, at last, the amount eliminated daily would equal the daily consumption, be this time five, ten, or more days. If, on the other hand, all the alcohol consumed is either oxidised or eliminated within twenty-four hours, no increase in the daily elimination will take place in consequence of the continuance of the alcohol diet. Guided by these considerations, the author undertook two series of experiments, in which the amount of alcohol eliminated by both kidneys and lungs was carefully estimated. The analytical processes employed are described in detail.

First Series.—After a total abstinence from alcohol for eleven days, the urine and breath were examined, after which, from the twelfth to the twenty-fourth day, both inclusive, the author took 112 c.c. of brandy daily (equal to 48·68 grms. absolute alcohol). The urine and breath were examined on the twelfth, the eighteenth, and the twenty-fourth day. The urine was also examined during the five days following the cessation of the alcohol diet. The analytical results obtained are given in a Table.

Second Series.—After having again abstained from the use of alcohol, in any shape, during ten days, the author took 56 c.c. of brandy (same as above) at 10 a.m. on March 29th. The urine was collected from three to three hours up to the twelfth, from the twelfth to the twenty-fourth, and during the next succeeding two days. The alcohol eliminated in the breath was also estimated during the same intervals. The analytical results are also arranged in a tabular form.

The results of both series may be summed up as follows:—

The amount of alcohol eliminated per day does not increase with the continuance of the alcohol diet; therefore all the alcohol consumed daily must, of necessity, be disposed of daily; and as it certainly is not eliminated within that time, it must be destroyed in the system.

The elimination of alcohol following the ingestion of a dose, or doses of alcohol ceases in from nine to twenty-four hours after the last dose has been taken.

The amount of alcohol eliminated, in both breath and urine, is a minute fraction only of the amount of alcohol taken.

In the course of these experiments, the author found that, after six weeks of total abstinence, and even in the case of a teetotaller, a substance is eliminated in the urine, and, perhaps, also in the breath, which, though apparently not alcohol, gives all the reactions ordinarily used for the detection of traces of alcohol, viz., it passes over with the first portions of the distillate, it yields acetic acid on oxidation, gives the emerald-green reaction with bichromate of potassium and strong sulphuric acid, yields iodoform, and its aqueous solution has a lower specific gravity and a higher vapour tension than pure water. The presence of a substance in human urine and the urine of various animals, which yields iodoform, but is not alcohol, had already been discovered by M. Lieben. The quantity present in urine is, however, so small that the precise nature of this substance has not as yet been determined.

Finally, the author points out an apparent connection between this substance and alcohol. It was found that, after the elimination due to the ingestion of alcohol had ceased, the amount of this substance eliminated in a given time at first remained below the quantity normally excreted, and only gradually rose again to the normal standard. A careful study of this connection may perhaps serve to throw some light upon the physiological action of alcohol.

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* Abstract of a Paper read before the Royal Society.

A STUDY OF CERTAIN TUNGSTEN COMPOUNDS.*

By Professor HENRY E. ROSCOE, Ph.D., F.R.S., &c.

The constitution of the tungsten compounds, the equivalent of the metal and even its elementary nature, are subjects upon which for many years serious doubts have been expressed. Thus Persoz, who at one time proposed to regard the so-called tungsten as containing two elements, at a subsequent date explained this by the assumption that the equivalent of tungsten and the formula of its highest oxide are not 184 and WO_3 respectively, but that the metal is one belonging to the arsenic group, having an atomic weight of 153, and forming a pentoxide and a pentachloride known as the tungstic compounds, together with a lower series which correspond to the lower arsenic compounds. This latter supposition, whilst unsupported by sufficient experimental evidence of its own to attract much attention from chemists, and contradicted by the important fact of the normal atomic heat of the metal corresponding to its old atomic weight, has never been satisfactorily proved to be incorrect, and has received a certain amount of corroboration from the subsequent vapour density determinations of the chloride of tungsten published by Debray. In this research Debray shows that the vapour density of tungstic chloride taken in mercury and sulphur vapours, is 168·5 ($H=1$), the normal density for WCl_6 ($W=184$) being 198·5; whereas that for Persoz's tungstic chloride, $TuCl_5$ ($Tu=153$), is 165, closely corresponding to the experimental density.

In order to clear up these questions, a thorough investigation of the chlorides and oxychlorides of tungsten, together with the corresponding bromine and iodine compounds, appeared before all things necessary.

The author then describes the mode employed for preparing pure metallic tungsten, which was found to possess a sp. gr. of 19·261 at 12° C.

The Chlorides of Tungsten.

1. *Tungsten Hexachloride*, WCl_6.—For the preparation of this chloride in the pure state it is absolutely necessary to exclude every trace of air or moisture. For this purpose the metal must be burnt in a current of perfectly dry and air-free chlorine, otherwise red oxychloride is formed, and this cannot be separated from the chloride, owing to the slight differences in their boiling-points.

Metallic tungsten takes fire in chlorine at a moderate heat. On heating the tube containing the metal a granular sublimate of dark violet opaque crystals of the hexachloride makes its appearance, which, when prepared in quantity, collects as a dark blackish red liquid. In order to purify it, this liquid is distilled several times in excess of chlorine, and then slowly rectified in a stream of hydrogen, by which means any traces of adhering oxychloride can be got rid of.

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* Read before the Manchester Literary and Philosophical Society January 23, 1872.

The dark violet-coloured crystals decrepitate on cooling, and the mass falls to a crystalline powder. When pure the solid hexachloride does not undergo any change, even in moist air, but in presence of the smallest trace of oxychloride it at once absorbs moisture, evolving fumes of hydrochloric acid, and changes from a violet to a brown colour. Cold water also acts very slowly on the pure substance, but, if impure, the mass is at once decomposed by cold water into a greenish oxide. The hexachloride is readily soluble in carbon disulphide, from which it is deposited in hexagonal plates. On several occasions the tubes containing the crystalline chloride exploded on opening them with a file, the crystals suddenly assuming the form of the decrepitated substance.

On decomposition with hot water a small quantity of chlorine is invariably retained by the tungstic acid formed, even after repeated distillation with water. Hence it was necessary in the analysis to reduce the oxide to metal and to collect the hydrochloric acid formed. This was effected by covering the weighed chloride in a porcelain boat with water, and bringing it into a bent combustion tube, one end of which was connected with a hydrogen evolution apparatus, and the other with a flask of water in which the acid was collected. On gently heating the fore part of the tube (the greatest care being taken to prevent spirting) the chloride is converted into the yellow oxide, after which it was more strongly heated and the reduced metallic tungsten weighed whilst the chlorine was estimated with silver.

Six analyses of different material, prepared on different occasions and according to different methods, yielded the following results:—

		Calculated.	Found.
Tungsten, W.. ..	184	46·35	46·49
Chlorine, Cl_6.. ..	213	53·65	53·32
	397	100·00	99·81

The exact determination of the melting-point of the hexachloride is attended with some difficulty, as the liquefaction takes place gradually, and the smallest traces of impurity depress the melting-point down to about 180° C., that given by the older observers. A mean of several experiments gave the number 275° C. (corrected) as the melting-point and 270° as the point of solidification. The constant boiling-point of the hexachloride was found to be 346·7° (corr.) under 759·5 m.m. of mercury. The vapour density of the hexachloride was determined (1) in sulphur vapour at 440°, and (2) in mercury vapour at 350°. As the hexachloride always leaves, on distillation, a small quantity of solid residue, the substance was distilled (either in a current of carbonic acid or of chlorine) into the heated bulb from a smaller one attached to it, according to the method adopted by the author in the determination of the vapour density of vanadium tetrachloride. The narrow neck of the bulb was kept open during the experiment by inserting a platinum wire, and after the sulphur or the mercury had been boiling for some minutes the neck was sealed.

The results of three experiments in sulphur vapour at 440° gave the density ($H=1$) as (1) 167·8, (2) 169·7, (3) 168·8. Two determinations in mercury vapour at 350° gave (1) 190·7, (2) 191·2.* The fact of the alteration of the vapour density from 190 at 350° (closely approaching the normal density, 198·5) to 167 at 440° shows pretty clearly that the anomalous vapour density is to be ascribed rather to dissociation than explained by Persoz's suggestion of an error in the atomic weight; and this conclusion is fully borne out by further experiments detailed in the sequel.

The residual chloride from the bulb possesses the same properties and composition as the original substance, there is no trace of free chlorine found in the cold bulb, nor does the colour of the vapour of the hexachloride change when it is strongly heated.

On heating the residue with water, a difference between its behaviour and that of the original hexachloride can, however, be detected, as the residue yielded an oxide which was perfectly yellow, but had a greenish colour, showing the existence of traces of oxides lower than WO_3, although present in too small quantity to affect the analysis.

In order to ascertain whether the gaseous hexachloride is decomposed at high temperatures, a portion of the pure chloride was distilled upwards in a current of dry carbonic acid for several hours. A continuous liberation of chlorine was clearly shown to occur, for, on passing the exit carbonic acid through a solution of potassium iodide, considerable quantities of iodine were liberated. The residual chloride was tested for lower chlorides by titrating a weighed quantity with a standard permanganate solution, which readily oxidises the blue oxide formed by the action of water on the pentachloride into tungstic acid. In one experiment thus conducted the residual chloride contained 3·3 per cent of pentachloride, whilst in another no less than 24·6 per cent of the pentachloride was formed. The pentachloride treated in a similar way yields no free chlorine, and therefore does not undergo a similar decomposition at high temperatures.

2. *Tungsten Pentachloride*, WCl_5.—On distilling the hexachloride in a current of hydrogen a reduction always takes place. If the temperature be kept but little above the boiling-point of the hexachloride, the dark red colour of the vapour is seen to vanish, and a light yellow-coloured vapour makes its appearance, which soon condenses into black drops or long shining black needles. After two or three distillations in hydrogen a pure product is obtained. Tungsten pentachloride crystallises in long black shining needles; if condensed in fine powder its colour is dark green, and the powdered crystals also possess a dark green colour like that of potassium manganate. The pentachloride is exceedingly hygroscopic, the crystals becoming instantly covered with a dark golden-green film on exposure to air, and small particles being instantly converted into drops. The crystals do not decrepitate like those of the hexachloride. On treatment with larger quantities of water the pentachloride gives rise to an olive-green solution, although the greater part of the chloride forms the blue oxide and hydrochloric acid. Analyses made with three separate preparations, according to the method already described, gave the following mean result:—

		Calculated.	Found.
Tungsten.. ..	$W =$ 184·0	50·89	50·90
Chlorine	$Cl_5 =$ 177·5	49·11	48·58
	361·5	100·00	99·48

Tungsten pentachloride melts completely at 248° C., and solidifies at 242°; the boiling-point is 275·6° (corr.). The vapour density of this chloride taken in sulphur vapour at 440° was found to be (1) 186·4, (2) 186·5, (3) 185·7; the normal calculated density ($H=1$) being 180·7.

Hence the molecule of pentachloride contains one atom ($W=184$) of metal.

3. *Tungsten Tetrachloride*, WCl_4.—The tetrachloride forms the non-volatile residue produced in the distillation of the hexachloride in hydrogen. In order to obtain it in a pure state the mixture of the two higher chlorides is distilled at a low temperature (best in a bath of melted sulphur) and in a current of dry hydrogen or carbonic acid. The tetrachloride is a loose soft crystalline powder of a greyish brown colour. It is highly hygroscopic, but not so much so as the pentachloride, and it is partially decomposed by cold water into brown oxide and hydrochloric acid, forming also a greenish brown solution which is rather more stable than the green solutions of the pentachloride in water. The tetrachloride is non-volatile and infusible under ordinary pressure, but it is

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* Rieth has lately determined the vapour density of "wolfram chlorid," showing that its molecule contains 187 instead of 184 of metal, but there is nothing to show whether the substance thus examined was the hexa- or the penta-chloride.

decomposed on heating into pentachloride, which distils off, and a lower dichloride which remains behind. On heating in hydrogen at a temperature above the melting-point of zinc, the tetrachloride is reduced to metallic tungsten, which is sometimes deposited as a black tinder-like mass, undergoing spontaneous ignition on exposure to the air.

Analyses of four portions gave the following mean numbers:—

		Calculated.	Found.
Tungsten	$W = 184$	56·45	57·22
Chlorine	$Cl_4 = 142$	43·55	42·24
	326	100·00	99·46

4. *Tungsten Dichloride*, WCl_2.—This body is formed in light grey crusts on reducing the hexachloride at high temperatures. It can be best prepared from the tetrachloride by heating in a moderately hot zinc bath.

The dichloride is a non-volatile loose grey powder, without lustre or crystalline structure. It undergoes change on short exposure to air, and is converted by water into brown oxide, with evolution of hydrogen. Analyses of two preparations gave as follows:—

		Calculated.	Found.
Tungsten	$W = 184$	72·15	73·00
Chlorine	$Cl_2 = 71$	27·85	26·35
	255	100·00	99·35

Experiments made in the endeavour to prepare the chlorides WCl_3 and WCl were unsuccessful.

5. *Tungsten Oxychlorides.* — The monoxychloride, $WOCl_4$, and the dioxychloride, WO_2Cl_2, have already been tolerably fully studied, nevertheless we find that Persoz actually doubts the existence of these well characterised compounds, and Debray, obtaining abnormal numbers for the vapour density of the first of these bodies, is unable to explain his results.

The splendid ruby-red needles of the monoxychloride are best obtained by passing the vapour of a chloride over heated oxide or dioxychloride in a current of chlorine. The crystals melt at 210·4°, and solidify at 206·7°; when heated more strongly the liquid boils at 227·5° C. (corrected) forming a red vapour rather lighter coloured than that of the hexachloride. On repeated distillation in chlorine over charcoal the hexachloride is formed. On exposure to air, the red crystals become at once coated with a yellow crust of the dioxychloride.

Analysis gave—

	Calculated.	Found.
Tungsten	$W = 53·80$	53·89
Chlorine	$Cl_4 = 41·52$	41·11
Oxygen	$O = 4·68$	
	100·00	

Debray found the vapour density of this body in sulphur vapour to be 148 ($H=1$), whereas the calculated density is 171. On repeating this determination, the numbers (1) 171·3 and (2) 171·7 were obtained; whilst experiments made in mercury vapour gave (1) 175·8, (2) 170·8, proving that the vapour density of the monoxychloride is normal, and that the molecule of this substance contains 184 parts of metal.

The Dioxychloride, WO_2Cl_2, is best prepared by passing chlorine over the brown dioxide. Analysis gave—

	Calculated.	Found.
Tungsten	$W = 64·32$	64·11
Chlorine	$Cl_2 = 24·31$	24·74
Oxygen..	$O_2 = 11·37$	
	100·00	

The vapour density of the dioxychloride cannot be determined at 440°, as at that temperature the contents of the bulb remains liquid.

(To be continued).

ON THE
ATOMIC WEIGHTS OF THE CHEMICAL ELEMENTS.

By S. E. PHILLIPS.

The subject of this paper is one upon which a considerable interest has been evinced, and the object of the writer is rather to ascertain *the truth* than to manifest a one-sided advocacy.

That many able men have endorsed the new views there can be no question, and that they should be wholly in error is extremely improbable; it is, however, to be lamented that some have evinced a tone of offensive superiority and assumption totally unwarranted.

In England especially the new views have become almost universally acknowledged; and it is no less clear that a wide feeling of dissatisfaction is felt, in regard to the variety and complexity of formulæ involved.

The great Dumas hesitates not to confess inability to read modern chemical memoirs on account of the complexity of formulæ indulged in, and the "barbarous" character of the nomenclature employed.

Professor Odling has eloquently rebuked the unwarranted liberties taken in the curious art of type building speculations, and the President of the Chemical Society has lifted up his voice against the notion of bonds, atomicities, &c., &c.

Professor Wanklyn, an eminent worker in the new field, says—"That the present formulæ (the doubled or diatomic), for salts of barium, calcium, magnesia, &c., should have come into general use, and that there should be next to no experimental support for these formulæ is a most extraordinary thing.

"The reasons in regard to some of these metals were partly some very doubtful deductions drawn from their specific heats, and mainly from considerations of the vapour density of certain metallic compounds."

Old Views.

Electro-combining equivalents have been determined by a varied scrutiny of the relative weights of atomic combinations as checked by all other available sources of rectification.

It is in this way the atomic weights have been established on the assumption that the ultimate atoms of bodies have their specific weights as $H = 1$, $O = 8$, Water $= 9$, Mercury $= 200$, &c.

Atomic Volumes.

It was long ago seen that an intimate relation subsists between the atomic weights and their specific volumes or vapour densities. It is, however, unfortunate that only a few of the elements are capable of admeasurement in the state of vapour, but indirect methods and theoretical determinations have justly added a value and interest to this class of atomic considerations. And whether modern chemists have laid too much stress on its guidance, apart from wider elements of control, is a fair question.

The law as at first proclaimed was, that equal volumes at equal pressure and temperature contained the same number of atoms. This is now understood as referring more to molecules than atoms.

In deference to this hypothetic law, because oxygen had only half the standard volume, its atomic weight was doubled, and similarly with other elements, water becoming $\left.\begin{array}{l}H\\H\end{array}\right\}\Theta = 18$ instead of $HO = 9$.

As in atomic chemistry it is seen that combinations take place, mostly in ratios of 1 to 1, but sometimes 1 to 2, or 1 to 3 (the inverse being 1 to $\frac{1}{2}$, 1 to $\frac{1}{3}$, &c.), so in like manner we now moot that the same principle predominates in the other affections of matter now under consideration.

As in the law of specific heats or that of refractive energies, so it would appear that volumetric combinations illustrate the same principle, not only at the onset, or in regard to the combining constituents, but also in regard to the products of combination. A few instances will show this—

$H + Cl = HCl$, the resulting chlorhydric acid being precisely the volume of its constituents; in other words, there is no condensation.

$H + O = HO$, where $1\frac{1}{2}$ volumes are condensed to one of water vapour.

$C + 2O = CO_2$, where two equal volumes of carbon and oxygen are condensed to one of carbonic acid gas, &c.

Saltic compounds mostly affect two vols., but this rule is far from being universal, as may be seen in the silicate of ethyl (silicic ether) and many others.

$2EO + SiO_2$ = silicate of ethyl, whose vapour density is 105·7; the atomic weight = 104; therefore a saltic condensation of 3 to 1, &c.

The process of halving or doubling old atomic weights to obviate anomalies could never have been tolerated but for the strange fatality which has attended the change—viz., that by a parallel movement all the chemical or dynamical considerations involved in electro-chemistry have been laid aside. Given a number of skittles with no inherent qualities beyond such as are derived from their attidude or position in the type, and it is at once seen what a wide scope there is for the varied numerical pleasantries which continue to be so prolific.

A striking illustration of this may be seen in the popular "Outline of Modern Chemistry," by Professor Hoffman. He uses the word *chemism* to express the dynamical or atomic forces involved, as we think, in all chemical phenomena; but the reference is only made once, and near the end of the book, and then only in a parenthetical way, as if to show its irrelevance while pourtraying the atomic mechanism of varied atomicities, varied quantivalences, atom-fixing powers, &c.

A reaction between oxide of silver and binoxide of hydrogen has given rise to much speculation, the character of which may be seen in the following equation:—

$$\underset{+\ -}{AgO} + \underset{+-+}{HOO} = Ag,\ HO,\ \text{and}\ \underset{-+}{OO}$$

where it is seen that free oxygen gas is considered an electro-binary, and this view is extended to other bodies. Thus—

$$\underset{+-}{HH} + \underset{+-}{OO} = \underset{+-}{HO},\ \underset{+-}{HO}.$$

It is indeed anomalous that men who have laid aside electro-binary principles, in favour of every conceivable form of numerical representation, should now so quixotically run a tilt at the grave of Berzelius, and apply to similar that which has been denied for opposite elements.

In another connection we have asked what can be the difference between 1 atom water—

$$\left.\begin{matrix}H\\H\end{matrix}\right\}\Theta$$

2 atom water—

$$\left.\begin{matrix}H\\H\\H\\H\end{matrix}\right\}\begin{matrix}\Theta\\\Theta\end{matrix}$$

up to 14 atom water; and we would now enquire if in the electro-decomposition of—

$$\underset{-+}{HO}$$

they ever expect to get the *negative* H given off at the zinc pole, and *vice versa* with the *positive* O.

It may seem strange that oxygen should be $\frac{1}{2}$ vol. while its chemical analogue, Cl, like that of H, is 1 vol., but this character of anomaly is of frequent occurrence both with elements and compounds.

Nitrogen is 1 vol.; phosphorus and arsenic are $\frac{1}{2}$ vols., but they are strictly congeners, and the difficulty vanishes in their compounds.

	Vols.	Density.	Atomic Weight.
$3H + N$ = Ammonia	2	8·5	17
$3H + P$ = Phosphonia ..	2	16·8	34
&c.,	&c.		

The case of oxygen is strictly analogous.

HO	1	9·0	9·0
CO	1	13·9	14·0
SnCl	1	(?)	94·5
CCl	$\frac{1}{2}$	84·0	41·5
SCl	1	67·8	67·5
&c.,	&c.		

As modern chemists have, perhaps, unwisely abandoned the method of indicating the doubled atoms by a cross line (thereby occasioning great trouble to some who either do not or will not understand the new arrangements), I have adopted it with a new signification. It bespeaks an atom of double weight or condensation, but which is not a duad in the modern acceptation—viz., it does not represent the equivalence of 2H, &c. (Chemical News, vol. xxi., p. 123).

An extended series of binoxides, bichlorides, &c., also agree.

		Vol.	Density.	Atomic Weight.
Carbonic acid,	CO_2 ..	1	22·10	22·00
Silicic acid,	SiO_2 ..	1	(?)	30·00
Stannic acid,	SnO_2 ..	1	(?)	75·00
Sulpho-carbonic,	CS_2 ..	1	38·20	38·00
Chlor-carbonic,	CCl_2 ..	1	76·50	77·00
	$ZrCl_2$ ..	1	167·20	165·50
	$SiCl_2$ ..	1	84·70	85·00
	$TiCl_2$ ..	1	98·70	96·00
	$SnCl_2$ ..	1	132·80	130·00
	SiI_2 ..	1	19·12	18·56
	CoCl ..	1	49·10	49·50

I presume that many of the sesqui-ides also affect 1 vol. oxalic acid—

C_2O_3 ..	1	—	36·0
C_2Cl_3 ..	1	117·7	118·5 solid.
C_2Cl_3 ..	2	58·8	118·5 liquid.
Al_2Cl_3	1	134·8	134·0
Al_2I_3 ..	1	389·9	408·5
Al_2Br_3	1	268·8	267·5
Fe_2Cl_3	1	164·4	162·5
Cr_2O_3 ..	1?	—	50·3
CrO_2Cl	1	80·0	77·8

with reference to the volumetric character of the compounds of O, Cl, and H, we might put the matter succinctly thus—

	Vol.		Vol.		Vol.
CO_2 ..	1	CH_2 ..	1	CCl_2 ..	1
C_2O_3 ..	1	C_2H_3 ..	1	C_2Cl_3 ..	1

The rule seems to be that proto-, bi-, and sesqui-ides mostly affect 1 vol., though with some exceptions, but with the ter-ides the rule seems to favour 2 vols.

	Vol.		
$BoCl_3$	2	56·8	117·5
$SbCl_3$	2	112·6	228·5
SbE_3	2	104·4	209·0
$BoMe_3$	2	27·9	56·0
$BoBr_3$	2	176·8	251·0
&c.,	&c.		

The same general symmetry with like departures may be abundantly traced in organic chemistry—of hydrides it may probably be affirmed that they always affect 2 vols.

$(C_4H_3O_2),H$	2	22·04″	44
$(C_4H_3Cl_2),H$	2	49·07″	99
&c.,	&c.		

It is plain, therefore, that when we isolate these radicals, their volumes will correspond with 1 vol., and their densities be strictly that of their atomic weights.

H..	1	1	1
$(C_4H_3O_2)$	1	43	43
$(C_4H_3Cl_2)$	1	98	98
(C_4H_5)	1	29	29
	&c.,	&c.	

It is now pretty well accepted that oxygen has a density of 16, while that of allotropic O as given off by electrolysis is 24, also that ordinary sulphur is 96, while that subjected to a temperature of 1900° is 32.

H	1	1	1
Oxygen	$\frac{1}{2}$	16	8
Ozone	$\frac{1}{3}$	24	8
Sulphur	$\frac{1}{6}$	96	16
Do. at 1900° F...	$\frac{1}{2}$	32	16

According to Ludwig the density of Cl as deduced from its atomic weight of 35-379 would be 2·45012.

At 20° C. he found 2·4807
,, 100° C. ,, 2·4685
,, 200° C. ,, 2·4502

In a paper on "Some New Sulpho-Salts" (CHEMICAL NEWS, vol. xxi., p. 122) I have referred to the allotropic or doubly condensed forms of copper, ammonia, carbonic oxide, &c., and the subject well demands a fuller investigation.

In both idic and saltic forms of combination, one of Cu (31·75) may be replaced to the preservation of the same type by an atom of Ꞓu (63·5), and in the case of CO (14) and H_3N (17) when replaced by ꞒƟ (28) and $\cancel{H_3N}$ (34), it is quite clear that not only are the types preserved but the volumes also.

This feeble glance at a subject so profound in its wide and important bearings, may well justify caution in halving or doubling atoms to satisfy any preconceived theory on the subject.

Specific Heats.

The rudest cook would readily perceive that, in boiling different fluids, varying amounts of heat are requisite, and closer investigation has shown, that while different elements require varying amounts of heat to raise equal weights 1°, yet within certain limits, that if these uniform weights be varied to correspond with their atomic weights, then the heat required to raise the substance 1° would be uniform and equal. Thus—

	Specific heat.
Water	1
Potassium	0·1696 × 39 = 6·61
Sodium	0·2934 × 23 = 6·75
Lithium	0·9408 × 7 = 6·59

Of course it is tempting to find herein the expression of universal law, but further examination will show that this has not yet been realised, and we are perplexingly confronted with the same ratios of half and other multiple variations.

The alkaline group gives a fair approximation to a mean constant of 6·65, but while O had its atomic weight doubled to square with volumetric consideration, the specific heat is 0·2175, which multiplied by 16 only gives 3·4 instead of 6·5! So that if we must get the specific heat right, then the vol. is as much too great as it was originally too small!

Then, again, if the specific heat of N and O (even when the latter is doubled) is too small, we find that of mercury and cadmium to be too great. Bloxam says—"the specific heat of mercury is twice as great as it should be if its atomic weight be 100, and this conjoined with *other considerations*, has led many chemists to adopt 200 as its atomic weight."

Here, then, is another dilemma. Old Chemistry said mercury was 200°; New Chemistry, after doubling several atoms, said this volume is too great, we must halve the atomic weight, and then, when numerous books and manuals of the science have been disfigured, Mr. Specific Heat steps in, and, with warmest assurance, states that 200 is right after all!

If we take H,Cu—Pb,Tl—Ba,Li, Old Chemistry teaches that while not a definitely select group, yet that these closely connected pairs all evince many characters in common. They all form protoxide bases, and mutually replace each other in similar saltic types, in the ratio of their atomic weights, but in electro-position and the further minutiæ of chemical characters, they constitute three pairs of closely allied elements. Their volumes we know not, but their specific heats do not conform to the law.

Lithium corresponds, but barium is about $\frac{1}{2}$, and hence its weight is doubled, and the symmetry of the plainest chemical analogies is violated, and the so-called protoxide and protochloride become ꞖaƟ and $BaCl_2$!

Thallium corresponds to theory, but lead, its perfect analogue, is about half, and hence its double weight and violated analogies.

H and Cu both correspond to about half values, but, strange to say, copper is doubled, while H is left alone in its half glory!

Then, again, if we take Cl and Br, two of the very closest chemical analogues with well-established atomic weights, and which correspond to equal volumes, yet here is an anomaly which no halving or doubling can rectify—

Cl = 4·309
Br = 6·746

Br has been considered 4·416, but recent researches with a varied temperature have given 6·74.

To get this, however, a temperature of 78° C. is necessary, and, as some elements require a temperature of 100° C. to approximate theory, here we have a difference of about 300° F, which detracts somewhat from the generality and close applicability of the supposed law.

As the temperature of the volumetric determination is a very vague element, so a like variation occurs with specific heat, and it is not a little curious that this should also point towards multiple ratios. If water be 1, then ice is $\frac{1}{2}$!

Specific Refractive Energies.

This subject is comparatively a new one, and has not yet been reduced to the level of a popular comprehension. The following is a very imperfect attempt to digest the results communicated to the Chemical Society by Dr. Gladstone:—

(1). The influence of temperature on the refraction of light by liquids decreases as the temperature rises, but there is a relation between the change of density and the change of refractive index, minus unity; whence the refractive energy becomes $v-1$, and this, divided by the density, gives the specific refractive energy a constant unaffected by temperature.

(2). As to combinations, compared with their constituents, Dulong essayed to show that the power of a mixture was the mean of its constituents, but we find the nearest approach to truth is given by $\frac{v-1}{d}$.

An element seems to retain its specific power of retarding rays when it is combined with other elements: the law appears to be that the power of any liquid is the sum of its constituents modified by the manner of combination.*

(3). As to different homologous compounds.

In the methyl series, the power increases as the series advances, the refraction equivalent becomes $\frac{v-1}{d} \times$ by the atomic weight. The equivalent of Ꞓ = 5, H = 1·3, Ɵ = 3, Thus ether = C_4H_{10}Ɵ = 4(5) + 10(1·3) + 3 = 36, and observation gives 36·26; but there are exceptions, the aromatic hydrocarbons and others greatly exceed the calculated numbers.

Fifty elements have been thus determined; some have a double value, and, in most cases, this is coincident with

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* Professor Andrews, in his inaugural address at the British Association last year, says,—"Later researches have shown that the specific refractive power depends chiefly on the atomic composition of the body, and is little influenced by the mode of grouping of the atoms.

a change of atomicity. Iron in the ferrous salts is 12·0, in the ferric salts 20·1; the iron of ferridcyanide of potassium = 11·7; and is therefore in the same condition as is the ferrous salts.

Oxygen presents great anomalies; in many cases it gives 2·9, in others 2·1, and in some a negative quantity!

It is remarkable that similar atomic weights give similar refraction equivalents, and this is the more striking when the specific refractive energies are compared—

Atomic weight.		R. equivalent.	Sp. R. energy.
Iron, Fe	= 56·0	12—20·1	0·214
Manganese, Mn	= 55·0	12·2—26·2	0·222
Aluminium, Al	= 27·5	8·4	0·307
Chromium, Cr	= 52·5	15·9—23·0	0·305
Bromine, Br	= 80·0	15·3—16·9	0·191
Iodine, I	= 127·0	24·5—27·2	0·193

But the most suggestive comparison is that between the specific refractive energies and the combining proportions of those metals that form salts not decomposable with water. (The actual amount which combines with a certain quantity of the salt radical).

	Specific refractive energy.	Proportion.	Atomic weight.	
			Old.	New.
H	1300	1·0	1·00	1·0
Al	307	9·1	13·75	27·5
Ca	260	20	20·00	40·0
Fe	214	28	28·00	56·0
Na	209	23	23·00	23·0
K..	207	39·1	39·10	32·1
Cu	183	31·7	31·70	63·5
Ag	125	108	108·00	108·0
Pb	120	103	103·50	207·0

This suggests that the combining proportions of silver, lead, &c., ought to be halved in order to bring these elements to about their right places in the list.

It is with much diffidence I make any remarks on a subject so little matured, but while the halving of elements seems very cogent in regard to the doubled or diatomic cases of the atomic lists which I have appended, still I do not see why silver and potassium should be thus interfered with. Nor can I see in the previous lists either the similarity of weights or that of refraction equivalents, and the whole matter, as in the previous sections, seems to demand a much fuller investigation before any rash liberties be taken with the chemical alphabet.

The ferrous salts are, in all probability, $FeO+SO_3$
The ferric salts ,, ,, $Fe_2O_3+3SO_3$
The ferridcyanides ,, ,, $3KCy+Fe_2Cy_3$

If this be right, it is opposed to the indication above given.

A subsequent memoir was read on the refraction equivalents of the aromatic hydrocarbons and their derivatives, in which is given an extended list of these bodies, the general results being that—

The essential oils are about 2 higher than theory
The phenyl group ,, ,, 6 ,, ,,
The naphthalen group ,, 14 ,, ,,
The anthracen ,, ,, 17 ,, ,,

Electrolytic and Calorific Relations.

By the very strict conditions of electrolytic interchange, it must happen that hereby is afforded a valid and crucial test of the relative weight of elementary bodies, and whether we consult the "Lecture Notes" of Professor Tyndall, or refer to any modern estimates, as apart from all attempt at theoretical explanation, we find a set of numbers fully in accordance with the old chemism of the subject—a class of consideration which perhaps far outweighs all the others in force and value, but which I cannot include within the limits of this sketch. Those numbers are as O = 8, H = 1, Zn = 32·5, K = 39·1, Cu = 31·75, &c.

Nor is there less of force and cogency in the laws of calorific energy.

It is very generally accepted that the electro-motive force is due to the difference of potential between the elements of any given battery equation and therefore it comes to the same thing whether we estimate this potential from an electric or from a calorific point of view.

If we employ zinc as the motor element in a battery we get a certain force of current; if we replace it with sodium we get a greater force; and if we employ potassium we obtain a force of current stronger in the ratio of its greater electro-remoteness from the negative or opposite oxygen. On this point the physicist is more advanced than the electrician, although his means of quantitative research are greatly more difficult.

He has determined with approximate precision the heat evolved in the combustion with oxygen of the several elements. We only cite two or three for illustration—

Hydrogen .. .. 1 = 34262
Zinc .. .. .. 32·5 = 42282
Sodium .. .. .. 23 = 73510
Potassium .. .. 39·1 = 76238

Now if zinc were really the diatomic of modern theory, and its smallest proportional weight were 63, then its calorific value as contended for by some would be 84564, or greater than that of the more energetic potassium, which is simply preposterous.

We are about to have an Electrical Society, which promises well for force and vitality, but in addition to the reproach involved in the above figures, and while other nations have electrical periodicals of high standing, it is lamentable that we have no journal devoted to such an important department, where England, impelled by a practical and pecuniary instinct, is constructing a nervous communication throughout the entire globe.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 1st, 1872.

Dr. Frankland, F.R.S., President, in the Chair.

After the minutes of the previous meeting had been read and confirmed, Messrs. Eltoft, Gerstl, Helm, and Martindale, and Lieut. Abney, were formally admitted members of the Society.

The following names were then read for the first time:—Messrs. Henry Baden Pritchard, James Ballantyne Hannay, J. Vincent Taylor, Robert William Atkinson, and Walter William Fisher, B.A.

For the second time—Lüdwig Mond, E. Packard, jun., J. Ruffle, F. J. Barrett, E. Handfield Morton, Ross Scott, M.A., and Edward Kinch.

For the third time—Professor William H. Chandler, Professor Charles F. Chandler, Ph.D., Benjamin P. Medcalf, and John Watts, D.Sc., who were then balloted for and duly elected.

A "*Note on the Crystalline Principle of Barbadoes Aloes*" was read by the author, W. A. Tilden, D.Sc., who, after referring to Dr. Stenhouse's examination of aloïn, stated that he had succeeded in obtaining from it a crystalline chlorine substitution compound by following the method employed by Stenhouse in chlorinating orcin, viz., by means of potassium chlorate and hydrochloric acid. The formula of the chloraloïn was—

$$C_{17}H_{15}Cl_3O_7,3H_2O,$$

which bears a temperature of 120° without decomposition, but loses the three of water. It is somewhat more soluble in boiling water than the corresponding bromine compound, crystallising out on cooling in long silky yellow needles; when treated with nitric acid and silver nitrate it furnishes oxalic and picric acids, but no chrysamic acid, whilst the original aloïn, when acted on by nitric acid, yields, besides oxalic and picric acids, nearly 40 per cent of chrysamic acid. As the reactions of aloïn, as well as its bromine and chlorine derivatives, show a marked analogy to those of orcin, the author intends extending the investigation.

The President thanked the author, in the name of the Society, for his interesting paper, and hoped that he would continue his researches on aloïn, as it would be very advantageous that this compound, which had, as it were, been wandering about so long without a place, should be classified.

A paper was then read by C. R. A. Wright, D.Sc. "*On the Relations between the Atomic Hypothesis and the Condensed Symbolic Expression of Chemical Facts and Changes known as Dissected* (*Structural*) *Formulæ.*" As it is impossible in the space at our disposal to give anything like a complete abstract of this elaborate paper, we must be content with placing before our readers a brief outline comprising the principal points. The author, after stating that the natural method of discussing any given hypothesis was first to enumerate facts and then to enunciate the theory, and show how far it accounted for these facts, proceeded to give definitions of the terms employed, a "*relative vapour volume unit*," or more briefly a "*volume*," being defined as the volume occupied by 1 grm. of hydrogen under given conditions, whilst the terms "specific gravity of vapours" referred to hydrogen, "element," "compound," and "allotropic modification of an element" are taken in the usual sense. The "combining number" of an element is the smallest number of grms. of that element contained in two volumes of the homogeneous vapour of any of its compounds, and the collocation of symbols and suffixes which express the quantitative composition of a compound by weight as well as by volume is termed a formula. In the case of most elements, moreover, it has been ascertained that their combining numbers are approximately inversely proportional to their specific heats, so that it may be said that the formulæ of bodies are fixed, from considerations of their quantitative volumetric composition in the case of volatile compounds, specific heat of non-volatile elements, and generalisations, analogies, and conventions of various kinds, occasionally leading to higher formulæ than the simplest integral formula. The author then discussed the question of isomorphism and the relation between the specific gravity, specific refractive energy, and boiling-point of a body and its formula, and went on to say that chemical reactions might be expressed by equations in which one or more formulæ occur on each side of the sign of equality: the most general form of such equation being $AB + CD = AC + BD$, where A, B, C, D, represent portions of formulæ which are associated together differently in the resulting products from what they are in the generators. If AB, CD, AC, BD, are the formulæ of two generators and two products respectively, the reaction is said to be one of *double decomposition*, and the portions of formulæ A, B, C, D, are termed *groups* or *radicals*, so that the radical is one or more symbols and suffixes capable of being transferred from one formula to another, the process indicated by this transfer being a chemical reaction. Before, however, it can be asserted that two bodies contain a common radical, a reaction must be formed whereby one of them is converted into the other; thus, water, caustic soda, and acetic acid are all said to contain the radical hydroxyl because of the following reactions:—

$$2H_2O + 2Na = H_2 + 2NaOH,$$
$$NaOH + C_2H_3OCl = NACl + C_2H_3O,OH,$$
$$C_2H_3OCl + H_2O = HCl + C_2H_3O,OH,$$

and similarly since the action of acetyl chloride on alcohol produces hydrogen chloride and acetic ether, it is inferred that the latter compound contains C_2H_3O, O, and C_2H_5, which may be represented by the *dissected formula* $C_2H_3O - O - C_2H_5$. Again, the action of water on acetyl chloride gives rise to the dissected formula C_2H_3O,OH for acetic acid, whilst the production of this acid from methyl cyanide gives rise to the differently dissected formula CH_3,CO_2H, but both these are expressed by the dissected formula CH_3,CO,OH. It is usually found, therefore, that formulæ thus dissected into very simple groups are capable of expressing all the reactions of the body in question.

In the latter part of his paper the author treats of the relations of the atomic hypothesis to the facts just mentioned as summed up in the symbolic expressions termed dissected formulæ, and shows how far these facts may be accounted for by the atomic hypothesis, distinctly stating, however, that the dissected formula of a compound does not represent, in space, the relative positions of the compound atoms, his endeavour having been to express as briefly as possible all the principle chemical facts involved in the discussion, in language unconnected with any theory, and then to show how far the atomic hypothesis is in accordance with these facts, and, that as the language of this hypothesis is not necessary for the enumeration of chemical facts, it would be desirable that it should be kept in its proper place in text-books, *i.e.*, after the enumeration of fundamental facts in language independent of theories, the atomic hypothesis should be mentioned as accounting for certain of these facts, and then dismissed from consideration.

On the conclusion of the paper a long and very interesting discussion ensued.

The President said that it was quite unnecessary to ask the Society to return thanks to Dr. Wright for his paper, as he knew they would all agree with him how necessary it was to recur to those fundamental facts upon which the huge superstructure of chemical science rests, but he thought that the atomic theory had assisted in clearly placing before our minds certain facts, and it was probable that without it we should not have made the progress we had done, considering the facility with which it lent itself to the expression of the various reactions of chemical compounds. He agreed with the author as to the loose and inaccurate manner in which the term atom was frequently employed not only to indicate the smallest portion of an element, but also groups of elements: it was, moreover, unnecessary, and he proposed to substitute in those cases the term "semi-molecule," which was somewhat longer certainly, but otherwise preferable.

Dr. Debus then made some remarks in favour of the employment of the atomic theory, and said that, although it was not now the fashion to read the old standard works of the great masters in chemical science, he would like to go back some sixty or seventy years, to the year 1806 or 1807, when one of the greatest chemists, Berzelius, was engaged in the examination of salts, and found that when neutral salts decompose each other, the resulting salts were neutral: with regard to an explanation of this that chemist said he was in utter darkness until the intelligence reached him from England of Dalton's theory, which came upon him like a flood of light.

Dr. Mills agreed with the author as to the possibility of doing without the atomic theory, but it had been considered a difficulty that if we discarded it we had nothing to put in its place. In the ordinary affairs of life, however, we acted differently; when anything bad came in our way we endeavoured to remove it without at all considering what we should put in its place. So with the atomic theory; it was much better in considering any reaction simply to look at the facts as they stood. Although what Dr. Debus had said about Berzelius was gratifying to our national feelings, it must be remembered that both Berzelius and Dalton were of a mechanical turn of mind, and that the great illumination which the former had received from Dalton's theory was not so much inherent in the theory itself, as an accident of Berzelius's mind.

Dr. Guthrie, after drawing attention to the resemblance in the manner in which the term atom was employed to that of the term catalytic force, referred to the use of the term dissociation, which he understood to mean that the atoms of some compounds in a vaporous state were supposed to be related in some way not absolutely in chemical union, and yet not disunited; this also strongly reminded him of the term catalytic action. Dr. Wright had said that one element could replace another, or was equivalent to it; now in a strict sense no case of this kind was known, as, if it were exactly equivalent, the compounds must be identical; metaphysically speaking, there was no real replacement in quantity as there was no real replacement in kind.

Dr. Wright, in reply, said that with respect to what Dr. Debus had said, he fully admitted that the atomic theory had been useful in illustrating facts, but at the same time was inclined to agree with Dr. Mills that the illumination which Berzelius received from it was due in great measure to the nature of that chemist's mind. For his own part he was disposed to regard its proper use as an algebraical expression of facts rather than as an hypothesis, and although he could not go so far as Dr. Mills in considering it a chemical evil, he had no doubt that a text-book could be written without the employment of the atomic theory. With regard to what Dr. Guthrie had said about replacement, he regarded chemical formulæ as expressions of facts, and not as indicating any particular theory of replacement.

When the vapour of any compound as NH_4Cl or H_2SO_4 in a state of dissociation was submitted to physical tests, such as diffusion, it was found not to be homogeneous; no doubt the term decomposition could be employed instead of dissociation to indicate this state.

Dr. Wright remarked further, in reply to an objection made by Dr. Guthrie that diffusion might itself decompose the vapours as it did in the case of the dialysis of certain salts, that in these salts the decomposition was caused by their solution, so that the phenomenon of diffusion was an effect and not the cause of their decomposition.

The President in his concluding remarks said that although it was comparatively easy to explain the fundamental facts of the science without the use of the atomic theory, when students had become more advanced they wanted some theory to classify and arrange those facts.

The meeting finally adjourned until Thursday, the 15th of February.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 23rd, 1872.

E. W. Binney, F.R.S., F.G.S., President, in the Chair.

The President exhibited to the meeting a large crystal of selenite, of an irregular form and 8 inches in length, given to him by Mr. Taylor, of Stretford. That gentleman informed him that it was from the mud which had been dredged out of the Suez Canal. When the mud came out of the dredge there was no appearance of crystals, but on its drying and being afterwards broken up they were found in the mass. The President said that he had noticed the formation of similar, but smaller, crystals of selenite in the clay taken out of the London and North Western Railway Tunnel during its formation through Primrose Hill. When the clay was first excavated there was no appearance of crystals in it, but after it had been exposed to the weather for a few months, on fracturing the clay these were found dispersed throughout its mass. He had also found crystals of selenite in the till or boulder clay at Egremont on the Mersey and at Blackpool; and the crystals, from their sharp edges, showed that they had been formed *in situ*, and had not come from a distance, as many of the stones in the deposit had undoubtedly done. He had also seen in coal mines the formation of small crystals of selenite nearly an inch long in a few weeks. In this case their formation was evidently due to water charged with carbonate of lime coming into the shaft from the overlying drift beds and finding its way down into the workings, and there mixing with water containing sulphate of iron derived from decomposed iron pyrites; the sulphuric acid of the iron going to the lime and forming sulphate of lime, whilst the carbonic acid once united to it went to the iron and formed carbonate of iron. He was not acquainted with the composition of the mud dredged out of the Suez Canal, and therefore could not speak with certainty, but probably the selenite was formed by a somewhat similar double decomposition to that last described.

Mr. Brockbank, F.G.S., exhibited a specimen of mineral wool, produced at the Conshohocken Iron Works, in America, by passing a steam jet through a stream of molten slag in its flow from the blast-furnace. It had a lustrous white fibre, singularly like cotton-wool from the pod. It can be made at a very trifling cost, and is likely to come into use for several purposes. It is said to be a very effectual non-conductor of heat, and this has led to its being used in the United States for the coating of steam-boilers and for the linings of refrigerators. Similar mineral wool is sometimes produced during the blowing in the Bessemer steel converters, but only in small quantities.

Mr. Brockbank also described a very simple mode of utilising slag, adopted at the George-Maria-Hütte Blast Furnaces, at Osnabrück, in Hanover. The molten slag is allowed to fall in a stream, from a height of about 8 feet, into water, and is thus formed into large bean-shaped gravel. From the water-tank it is lifted into railway-trucks by "Jacob's ladders," and is conveyed away as fast as it is produced, and largely used for metalling railways.

In some of the English iron works the slag is now being broken up by Blake's stone-breakers, and sold for metalling roads; and in this way it proves a source of profit, instead of being a considerable loss in its usual form of huge heaps of slag, disfiguring the country.

The Bessemer slags of the hæmatite furnaces are found to make excellent concrete, on account of the large quantity of lime they contain; they are also peculiarly suitable for manuring potatoes and barley, as they fall to powder under the action of the atmosphere and yield up their silica and lime to enrich the land.

CORRESPONDENCE.

A NEW ALKALIMETER.

To the Editor of the Chemical News.

Sir,—Having observed that all the alkalimeters in use are more or less defective, I have set myself to work to remedy their defects by inventing one which shall attain perfect accuracy.

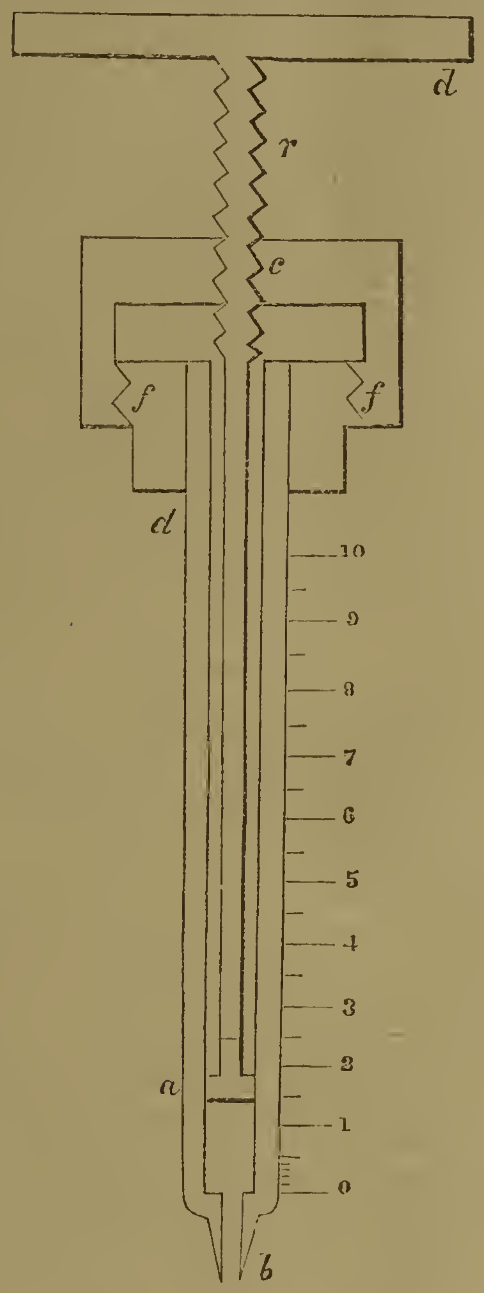
Knowing the wide circulation of your valuable journal among scientific men, I venture to forward you a description and drawing. It consists of a glass cylinder, *a a*, 13 centimetres in length, similar to an ordinary glass syringe, divided into centimetres, and with an interior diameter of 75 m.m.

On the top of the cylinder is fitted a brass screw cap, in which works the piston rod, consisting of a screw, *r*, which extends its whole length, the pitch of which is two threads to the centimetre. The piston and rod are of brass; the former is platinised and surrounded by a fine india-rubber washer. The handle of the piston-rod is a drum, the circumference of which is divided into fifty parts. The instrument fits into a wooden stand similarly to Möhr's.

To use the alkalimeter immerse the inferior orifice, *b*, in the liquid, and screw up the piston until the required quantity is drawn up, then turn the instrument upside down, and turn the piston round once or twice, so as to expel any air that may be between it and the liquid, then replace the instrument in its stand.

For every grm. required turn the piston round twice, and for every decigramme turn the drum round one-fifth of its circumference, and for every centigramme one-fiftieth.

The interior diameter of the tube being 0·75 centimetres will give an interior area of 1 square centimetre, and, consequently, each length of a centimetre will contain 1 c.c. of water or a grm.; and as at each evolution of the piston it will descend 5 m.m. half a grm. will be expelled, and for every fifth of an evolution of the drum a decigramme, &c.



To clean the instrument, the cap unscrews at *f*.—I am, &c.,

Chimiste.

MISCELLANEOUS.

Fletcher's Gas Furnace and Hot-Blast Blowpipe.—The speciality of this furnace is the burner. It is as simple as an ordinary Bunsen's burner, but the flame is solid to the centre. Copper will fuse in any part of the flame; and to make a crucible furnace simply requires a support for the crucible, and a fire-clay jacket to prevent radiation. The lower part is a chamber 6 in. by 3 in., open at the bottom, in which the gas is partially mixed with air. This mixture is conducted to the top of the burner through a mass of fine tubes, with an arrangement to supply between each exactly the amount of air necessary to consume it instantly. A flame produced by this means, consuming 20 feet of gas per hour, is about 2 inches high and almost colourless. The whole of the available heat is generated below the object to be heated, which, therefore, is not also cooled by the passage of unburnt gas and air. The point of greatest heat commences, as with a blowpipe, at the point of the blue cones, about $\frac{1}{2}$ in. or $\frac{3}{4}$ in. above the tubes; and if the flame is protected with a ring of fire-clay, continues uniform for some inches above. The great heating power of the hot-blast blowpipe is obtained by an arrangement which enables both gas and air to be supplied to the jet at an exceedingly high temperature. The jet will fuse a strand of 6 or 8 fine platina wires into a bead with a small point of flame, and will give a small light with a cylinder of lime. With the gas fully turned on, it will melt 3 ozs. of 18-carat gold on pumice-stone. Steel wire burns readily, with brilliant scintillations, and wrought-iron wire is readily fused. The additional heating power may be used or not, at will, and the blowpipe can be used either with the mouth or a foot blower; when used with the mouth the head is not confined in one position, as in case of the old form, and both hands are at liberty. The extreme power is exerted to the best advantage on as small objects as possible, and when the gas is turned down to a blue cone of about 1 or $1\frac{1}{2}$ inches long. The point of this blue cone will fuse a few grains of platinum, supported on lime, in five or six seconds, if a foot blower is used. If, however, a smaller quantity is taken—say half a grain—it is fused into a bead instantly, either with the mouth or a foot blower. If a platinum wire is used, it should be held with the point exactly in front of the point of the blue cone. With care, a bead may be fused on the end of a platinum wire almost as thick as ordinary copper bell wire. If a very fine wire is used, it will melt almost as quickly as it can be passed along the flame: in these experiments the eyes should be protected from the blinding glare of light, more especially in fusions on lime. For soldering and heating platinum crucibles, the gas should be turned full on, so as to produce a large rough flame, the heating power of which is about double that of the ordinary blowpipe. The lower burners need never be turned on more than is necessary to allow the flame just to reach the top of the coil. A trial of these apparatus in our laboratory has proved them to be most useful, but there is room for great improvement in the workmanship.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, January 2, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Electric Currents Obtained by the Bending of Metals.—P. Volpicelli.—The author first refers to the labours of Dr. Peltier on this subject, and, after relating at length his method of experimenting, summarises the results of his experiments in the following points:—All metals when being bent or twisted give rise to the development of an electric current, but copper exhibits this phenomenon in the highest degree. Lead, although not an elastic metal, also gives rise to the generation of an electric current, thus exhibiting an instance of the conversion of mechanical force into electricity; the electric currents thus produced are not perceptibly due to the development of heat due to the action of bending or twisting. When the bending is accompanied by the tearing asunder, or, rather, the distending, of the two ends of the metallic wire, a current is produced in an opposite direction from that obtained by putting the two ends nearer together; by increasing or decreasing the velocity of the bending, the intensity of the electric current is also increased or decreased. A metallic wire made of various metals soldered together produces, other conditions being the same, a less intense current by bending than when the wire is made of one and the same metal.

Condition of Substances when in Solution; Salts of Peroxide of Iron.—Dr. Berthelot.—The continuation of an exhaustive monograph on this subject. It appears that, when in solution, the peroxide of iron and the acids are united together only in a very loose manner, the decomposing action of the water becomes more conspicuous in the case of salts of the weaker acids—the ferric acetate, for instance; this decomposing effect increases with the larger proportion of the quantity of water, and also with elevation of temperature. It appears that, when once loosened from its union with acids, peroxide of iron assumes a peculiar molecular state, by which it is prevented entering again (while in solution) into union with the acid it has been combined to.

Spontaneous Decomposition of Divers Bisulphites.—C. Saint-Pierre.—Bisulphite of potassa, in concentrated or in weak solution, is spontaneously decomposed when exposed to a high temperature in closed vessels, giving rise to the formation of sulphur, sulphuric acid, and one or more of the acids of the thionic series. Sulphurous acid resists decomposition under the conditions alluded to; the bisulphites yield under the conditions just mentioned more sulphuric acid than can be saturated by the base present.

Researches on the Physiological Properties and Metamorphoses which Cyanates Undergo when Introduced into the Human System.—Drs. Rambuteau and Massul.—It appears from the authors' researches that alkaline cyanates when given internally become alkaline carbonates, as is the case also with acetates, lactates, and tartrates of potassa and soda; urea introduced into the stomach, or injected into the veins, is found again in the urine, while cyanate of ammonia, isomeric with urea, is converted into carbonate of ammonia.

January 8, 1872.

The following original papers and memoirs more particularly relating to chemistry are published in this number:—

Memoir on the Chemical Effects Due to the Calorific Action of Powerful Electric Discharges.—M. Becquerel.—After describing minutely and at length his apparatus and method of experimenting, the eminent *savant* states that the reduction of the oxides of silver, lead, tin, and copper is obtained by mixing these substances with some charcoal-dust, and exposing them to the heat derived from an electric discharge (powerful induction apparatus) in U-shaped tubes, while the oxides of nickel, cobalt, iron, and chromium, similarly mixed with charcoal-powder and some powdered sugar, and put into a platinum crucible, are also reduced; silica and alumina are fused, and sometimes small crystals are found in the fused mass.

Saccharine Substance Met with on a Lime-Tree (Tilia Europea).—Dr. Boussingault.—The author records in this lengthy memoir the results of his investigations on what is usually termed honey-dew—the appearance upon the leaves of certain trees of a kind of saccharine substance, which, curiously enough, was in this instance found to exhibit a very great similarity to the manna of Sinai and Kurdistan (formed, according to the researches of Ehrenberg and Hemprich, by the puncture of a kind of *Coccus* insect on the leaves of the *Tamaris mannifera*). The honey-dew *(miellée)* just alluded to was found to consist, in 100 parts, and collected at two different periods of time a fortnight distant from each other, of—(*a*). Cane sugar, 48·86; inverted sugar, 28·59; dextrin, 22·55. (*b*). Cane sugar, 55·44; inverted sugar, 24·75; dextrin, 19·81. Composition of the manna of Sinai, analysed by Dr. Berthelot—Cane sugar, 55 per cent; inverted sugar, 25; dextrin, 20; total, 100. For an equal square surface the quantity of honey-dew on the unhealthy leaves of the tree was far larger than that contained on the healthy leaves.

Relation Existing between Capillary Action and the Density (Specific Gravity) of Saline Solutions.—C. A. Valson.

Action of Heat upon Oxychlorides of Silicium.—L. Troost and P. Hautefeuille.—The authors record at great length the results of a series of experiments made with the oxychloride, $Si_4O_2Cl_6$. The chief point of interest is that the compound alluded to is partly decomposed when submitted to the action of heat, giving rise to the formation of more oxygenated and more condensed oxychlorides, while a portion also of the original compound is regenerated.

Action of Iodide of Lead upon some Metallic Acetates.—D. Tommasi.—The acetates can be, in this respect, divided into three groups, viz.—Acetates which combine with iodide of lead; only the acetate of potassium does this. Acetates which, while reacting upon the iodide, give rise to the phenomenon of double decomposition; the acetates of copper and mercury. Acetates which act upon the iodide of lead simply as solvents; such as the acetates of sodium, ammonium, lithium, calcium, barium, magnesium, zinc, manganese, chromium, iron, cobalt, aluminium, and uranium.

Chemical Investigation of a Complex Alum Obtained from the Thermo-Mineral Water of the Solfatara of Pouzzoles (near Naples).—S. de Luca.—After first referring to researches made on this subject more than a year ago, the author states that by the slow and spontaneous evaporation of the water just alluded to (it contains free sulphuric acid) there is formed a complex alum, which crystallographically corresponds to this well-known salt in every respect; sp. gr. at 17° = 1·774; it consists, in 100 parts, of—Sulphuric acid, 36·74; alumina, 6·70; ammonia, 10·82; peroxide of iron, 0·97; protoxide of iron, 1·10; lime, 0·65; magnesia, 0·30; potassa, 0·17; water, 40·98; soda, manganese, and loss, 1·57. The quantity of sulphuric acid suffices to saturate the bases present as protoxides, as well as the sesqui-oxides of iron and aluminium, thus constituting several sulphates, which, by their union, form a complex alum.

Although not belonging to the subjects usually treated of in this periodical, we call attention to the following work:—

L'Administration Militaire dans l'Antiquité.—M. Gauldrée-Boileau.—The eminent *savant* M. J. Dumas, as Perpetual Secretary of the French Academy of Sciences, calls special attention to this volume (presented by its author to the Academy), a work treating minutely and with very great precision on the military matters of the Romans and Greeks, the conclusion being that even in our days we may learn from the ancients.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 11, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Law of the Formation of the Lichtenberg Figures.—W. von Bezold.—An exhaustive memoir, illustrated by a series of engravings.

Continuation of the Essay on the Influence of Astronomical Motions on Optical Phenomena.—E. Ketteler.

Mineralogical Communications.—G. vom Rath.—This portion of this lengthy memoir contains the following sections:—On the chemical composition of some varieties of orthoclase; on the erbysite of l'argas; on the occurrence of sahlite (lime-magnesia-iron-augit) in the Pennine Alps; interesting excrescence of wollastonite from Monte-Somma; on allophan from Dehrn, near Limburg, in Nassau. This essay is to be continued; its contents, although interesting in a scientific point of view, are not well suited for useful abstraction.

Alleged Presence of Vesicles of Vapour in the Atmosphere.—J. Kober.—The author reviews in this essay the value of the opinions of a large number of *savants* belonging to various countries on the subject mentioned, and next quotes experiments from which he comes to the conclusion that the arguments brought forward to sustain the view of the presence of vesicles of aqueous vapour in our atmosphere do not hold good. The watery vapour present in the atmosphere consists of larger or smaller solid drops *(soliden tröpfchen)*; the drops of water floating about in the atmosphere become covered with a more or less thick layer of air; these drops so enveloped with air often form conglomerations. The falling downwards of these drops of fluid is not only prevented by ascending currents of air, but also by adhesive force.

Elementary Derivation of the Fundamental Equation of the Dynamical Theory of the Gases.—Dr. L. Pfaundler.—A mathematico-physical memoir.

Remarkable Observation Made with the Gold-Leaf Electrometer.—Dr. A. Forster.—The contents of this paper are, notwithstanding its intrinsic value, not suited for useful abstraction, an observation also relating to the following essays:—

Action of Electricity upon Liquids.—W. Beetz.

Spectroscopical Observation of the Sun's Rotation, and on a Newly-Arranged Reversion Spectroscope.—F. Zöllner.

Two New Methods of the Measurement of the Height of the Clouds.—Dr. Feussner.

Simple Thermo-Regulator.—E. Reichert.—Illustrated by engravings. An excellent contrivance for keeping up with either gas or petroleum-oil lamp a constant temperature for any length of time.

Sound of the Tingling in the Ears.—J. J. Oppel.

Extraordinary Formation of Ozone.—Dr. Pincus.—The author states that, if perfectly pure dried hydrogen gas is caused to burn in a very small flame from a jet ending in a very fine point, the smell of ozone is very distinctly perceived, and it becomes more conspicuous if a dry and clean beaker-glass is held over the flame. When, by the aid of a properly contrived apparatus, the combustion takes place in pure oxygen, the same phenomenon is observed.

Journal für Gasbeleuchtung und Wasserversorgung, No. 23, 1871.

The contents of this number relate strictly to matters belonging to gas- and water-works' engineering and management. We notice, however, that the oxyhydrogen method of gas-lighting of Tessié du Motay has been introduced for the lighting of the extensive railway-station of the Empress Elizabeth line of railway at Vienna, and that the process far exceeds the expectation of all who have witnessed its application there.

No. 24, 1871.

The original papers contained in this number bear strictly upon matters connected with gas- and water-works.

Bayerisches Industrie und Gewerbe Blatt, January, 1872.

This number, which opens with a short notice intimating that the November and December numbers of last year are yet in the press, contains the following original papers and memoirs relating to chemistry and allied subjects:—

Notice on a Pavement Made of Compressed Asphalte at Munich.—A. Zenetti.—This paper contains an excellent historico-technical account on the subject of asphalte pavements in general.

Estimation of the Hardness of Water for Technical and Scientific Purposes.—A. Wagner.—The greater portion of this lengthy memoir treats on the faults and difficulty of proper manipulation of the Clarke-Wilson soap test, and on the influence of the presence of magnesia salts in water as affecting the results of hardness obtained by this mode of testing. In the next place, the author states that for the knowledge of the quality of any kind of water it is only necessary first to estimate, by a carefully-made evaporation of a certain bulk of water (100 c.c. for very hard, and up to 500 c.c. for very soft), the total quantity of saline constituents, and next to ascertain the quantity of saline matter soluble in water present therein. It is further stated that the error due to the decomposition of chloride of magnesium and organic matter is so small as not to affect the general result, especially for technical purposes.

Lightning and Lightning-Rods and Conductors.—M. Landsberg.—This exhaustive essay, illustrated by a series of woodcuts, contains a very excellent review of all matters, scientific as well as practical, belonging to this subject.

Description of an Apparatus for Boiling Linseed Oil, Arranged to Render Innocuous the Pungent Vapours Evolved.—Dr. G. Feichtinger.—Illustrated by a woodcut.

Dinas Fire-Bricks; Quartz Bricks.—Dr. Bischof.—The author treats on the mode of manufacture of a peculiar kind of fire-brick made near Neath, in Wales, from a raw material locally known as the Dinas sandstone.

Noxious Effects of the Tar Colours on the Human Organism.—W. Mayer.—The author states that, as regards the aniline colours, if pure and properly made they are not poisonous, but that, in consequence of imperfections in the preparation, these pigments often contain arsenic and picric acid, to which is due the poisonous action of these substances, while, as regards the phenol pigments (rosolic acid [aurin], corallin, and azulin) they are seldom, if ever, quite free from phenol, and hence poisonous.

Utilisation of Tin Scraps.—A. Ott.—This essay contains an exhaustive review of all that has been preposed and practically done for the purpose of utilising the tin and sheet-iron of which the tin scraps are composed.

Bibliography.—Under this heading we call attention to the following work:—"Technologische Wandtafeln herausgegeben," von Dr. Friedrich Knapp, Bestehend aus 64 Colorirten Blättern Gröszten Formates und Ebenso Vielen Textblättern. This collection of 64 coloured plates, each 4 ft. 8 in. high by 3 ft. 8 in. wide, contains the carefully executed drawings of the best and most recent apparatus and machinery used in all branches of industry. The plates are sold varnished and ready for use in colleges and schools; the entire collection, with descriptive text, is sold at £6 10s.

Zeitschrift für Chemie von Beilstein, No. 15, 1871.

The following original papers and memoirs are contained in this number:—

Bromated Benzol-Sulpho Acid.—R. Fittig.—The author first reviews the labours of A. R. Garrick on this subject published in this periodical some years ago. It appears that the author prepared a large quantity of iso-brom-benzol-sulpho acid, the potassa salt of which, having been fused with excess of caustic potassa, yielded, after treatment with water and purification, pure resorcin, thus leading to the same result as that obtained by the chemist above named; it was further ascertained that hydrochinon is also formed.

Dinitro-Phenols.—W. Schneider.—While nitrating mono-nitrophenol according to Körner's process, the author observed the formation of two isomeric dinitro-phenols, one of which is identical with the dinitro-phenol obtained from ortho-nitro-phenol; the other is isomeric therewith, fuses at from 61° to 62°, is soluble in water, crystallises on evaporation of the solvent, and is readily soluble in alcohol and ether. The salts of this dinitro-phenol are distinguished from those of the other dinitro-phenol by a different degree of solubility, and the baryta salt of the dinitro-phenol fusing at between 61° and 62° is especially different by its greater insolubility in cold water; the salt crystallises in bright yellow-coloured crystals; formula, $(C_6H_3(NO_2)_2O)_2Ba+H_2O$. The formula of the dinitro-phenol alluded to is $C_6H_3(NO_2)_2NH$.

Nature of the Coal-Tar Oil Products Boiling between 161° and 169°.—P. Jannasch.—When coal-tar oil of high boiling-point is first treated with hot and concentrated caustic soda ley for the purpose of eliminating carbolic acid, and next rectified over sodium, the result is that there are obtained two substances, one of which boils at between 161° and 165°, and the other at between 165° and 169°; these products (not further specified) yield, on being treated with bromine, large crystals fusing at between 86° and 87°, but become decomposed at a higher temperature, and even cannot bear boiling with alcohol. By elementary analysis of this body, results were obtained leading to the formula $C_8H_6Br_2O$. Treated with nitric acid, these crystals yield picric acid; treated with sodium amalgam, they yield a solid crystalline mono-bromated product, boiling at from 212° to 216°, fusing at between 38° and 39°, and very soluble in ether, benzol, chloroform, and alcohol.

Dibromo-Pseudo-Cumol.—P. Jannasch and H. Süssenguth.—The authors obtained by the bromising of coal-tar oil, pseudo-cumol among other substances, a crystalline body, sparingly soluble in cold alcohol, more readily so in that liquid when hot, and very readily soluble in ether, benzol, and chloroform; formula, $C_9H_{10}Br_2$; point of fusion, 63° to 64°; boiling-point, 277° to 278°.

The American Journal of Science and Arts, January, 1872.

In addition to several important papers relating to geology, mineralogy, astronomy, and natural history, this number contains the following papers relating to chemistry:—

Relative Proportion of Iron and Sulphur in the Pyrites Contained in Several Specimens of Iowa Coal.—R. Emery.—This investigation was undertaken with the view to ascertain the correctness of the statement made by Prof. Wormley, who, on analysing the Ohio coal, found an amount of sulphur too large for combination with iron as FeS_2. The results of this research of the Iowa coal (ten samples) are that in four of these samples the quantity of sulphur corresponded to that of the formula FeS_2, in four other samples a marked excess of sulphur was found, while in two of the samples S was deficient to form with Fe the compound FeS_2.

Occurrence in Nature of Amorphous Mercuric Sulphide.—Dr. G. E. Moore.—This essay contains the very minute and extensive description of a peculiar mercury ore met with in California, which on analysis was found to consist, in 100 parts, of—HgS, 98·92; FeS_2, 0·83; quartz, 0·25.

Composition of the Labradorite Rocks of Waterville, New Hampshire.—E. S. Dana.—The detailed account of the mineralogical characters and chemical composition of some rocks and minerals of the locality alluded to.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, December 28, 1871.

This number does not contain any original papers relating to chemistry, but we notice a short paper:—

Consumption of Horse-Flesh in Paris.—Dr. Decroix.—From the contents of this paper it appears that since July 9, 1866, when the sale of horse-flesh was first commenced under proper sanitary supervision, up to the present day, the consumption of this meat as human food has steadily increased, 70,000 horses having been consumed during the late siege in Paris alone. The author estimates that annually 200,000 horses can be readily supplied for consumption of meat in France, and, taking the average weight of meat suitable for consumption of each horse at 200 kilos., this will yield 40,000,000 kilos. of horse-flesh for consumption.

Bibliography.—Under this heading is published here a review of the work—"Cours Elémentaire," par M. Stanislas Meunier, Dunod, Editeur, 49, Quai des Augustins, à Paris. The author of this work is well and deservedly known as a very emiment geologist in France as well as abroad; this work is highly spoken of by the reviewer, Dr. F. Hamel, who states that the author's aim to produce a really practical and lucidly written work on this subject has been thoroughly accomplished in the compact space of 460 pages.

NOTES AND QUERIES.

Ulex's Test.—Will any of your readers have the goodness to inform "Silex" what is "Ulex's test" as applied to kainit or crude potash salts in estimating the sulphate of potash.

Organic Chemistry—Dialysis—Hydrogen Musical Flame.—Is there any book on Organic Chemistry which you could recommend for students in which is to be found an orderly division of the matter, and someting like a philosophical arrangement of principles? The frequent omission of Organic Chemistry in the text-books for beginners makes me fear that there is a general feeling of the matter being too difficult for such students; still, would it not be possible to give them some outline of principles? What is the received opinion in England of "dialysis," "diffusion," "osmose;" are they one and the same thing, or not? I perceive that the French authorities hold that they are all three the same, at least in principle. Graham's notions of colloid and crystalloid are not received at all. A curious phenomenon showed itself during class this morning: a hydrogen flame sounded steadily, without any tube surrounding it. The source of the sound seemed to be in the hydrogen bottle; it could be heard from the gas-leading tube, when this was removed from the jet. The flame increased the strength, but did not change the tone.—E. KERNAN, Clongowes.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 12th.—Medical, 8.
—— Royal Geographical, 8.30.
—— London Institution, 4. Prof. Odling, F.R.S., on "Elementary Chemistry."
TUESDAY, 13th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Photographic, 8. Anniversary.
WEDNESDAY, 14th.—Society of Arts, 8.
—— London Institution, 6.30. Conversazione. Lecture on "The Sun," by Mr. Norman Lockyer, F.R.S.
THURSDAY, 15th.—Royal, 8.30.
—— Royal Society Club, 6.
—— Chemical, 8.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
FRIDAY, 16th.—Royal Institution, 9. Dr. Gladstone, F.R.S, "On the Crystallisation of Silver and other Metals."
SATURDAY, 17th.—Royal Institution, 3. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

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THE CHEMICAL NEWS.

VOL. XXV. No. 638.

A STUDY OF CERTAIN TUNGSTEN COMPOUNDS.*

By Professor HENRY E. ROSCOE, Ph.D., F.R.S., &c.

(Concluded from p. 63.)

Bromides of Tungsten.

BROMINE vapour acts rapidly on hot metallic tungsten, forming dark bromine-like vapours which condense to a crystalline sublimate. Especial precautions require to be employed as regards exclusion of oxygen and moisture, as the oxybromide formed when these substances are present possesses very nearly the same colour as the bromide, and cannot be easily separated from the latter.

Tungsten Pentabromide, WBr_5.—By the action of excess of bromine on tungsten a penta- and not a hexa-bromide is obtained. Prepared in this way, the pentabromide forms dark shining crystals having a metallic lustre not unlike that of iodine. These crystals melt at 276° and solidify at 273°, the liquid boiling at 333° (corr.). The pentabromide is at once decomposed by excess of water into the blue oxide of tungsten and hydrobromic acid, and immediately undergoes the same decomposition on exposure to moist air. On distillation, a small quantity of a lower non-volatile bromide remains behind, and this explains the slightly too high percentage of metal found in the analysis.

		Calculated.	Found.
Tungsten	$W = 184$	31·51	32·49
Bromine	$Br_5 = 400$	68·49	67·74
	584	100·00	100·23

When the pentabromide is heated to 350° in a current of hydrogen, a substance is obtained which appears to correspond to WBr_3, but this is very readily decomposed, and the dibromide, WBr_2, is formed as a black velvety powder. Analysis gave—

		Calculated.	Found.
Tungsten.. ..	$W = 184$	53·49	52·03
Bromine	$Br_2 = 160$	46·51	46·26
	344	100·00	99·29

Oxybromides of Tungsten.—The monoxybromide, $WOBr_4$, is formed, together with the dioxybromide, $WOBr_2$, by acting on a mixture of 1 part of metal and 2 parts of tungsten dioxide with bromine. It forms shining brownish black needles, which are easily fusible, and can be separated from the dioxybromide by gentle sublimation, when the latter compound remains behind. The monoxybromide melts at 277° and boils at 327·5°, and is readily acted on by water.

The mean of four analyses gives—

		Calculated.	Found.
Tungsten	$W = 184$	35·38	36·69
Bromine	$Br_4 = 320$	61·54	61·04
Oxygen	$O = 16$	3·08	
	520	100·00	

The dioxybromide, WO_2Br_2, is formed as light reddish brown vapours, which condense to reddish-brown coloured crystals by passing the vapour of the pentabromide over tungsten trioxide. The crystals do not melt, but volatilise at a temperature near to a red heat, and they are not acted on by water.

Analysis of four samples gave—

		Calculated.	Found.
Tungsten	$W = 184$	48·94	49·18
Bromine	$Br_2 = 160$	42·55	42·05
Oxygen	$O_2 = 32$	8·51	
	376	100·00	

Iodide of Tungsten, WI_2.

On passing iodine vapour, together with carbonic acid, over metallic tungsten heated to redness, a very small quantity of soft scaly crystals having a greenish metallic lustre is found to sublime. The same substance is formed (but also in small quantities) when iodine vapour is passed over the heated brown oxide or a mixture of metal and oxide. The product was analysed by passing air over the heated iodide, when it is readily converted into tungstic acid, iodine being liberated. The iodide is infusible and cannot be re-distilled without decomposition, and it is not immediately acted on by water.

Analysis gave—

		Calculated.	Found.
Tungsten	$W = 184$	42·01	42·95
Iodine..	$I_2 = 254$	57·99	56·64
	438	100·00	99·59

Atomic Weight of Tungsten.

1. *By Reduction of Tungsten Trioxide.*—The difficulty of obtaining perfectly pure tungstic acid and the effect which impurity produces on the atomic weight determinations has been pointed out by Dumas. In order to avoid the danger to which all the former determinations are subject, consequent upon the partial reduction of the acid to green oxide which cannot again be oxidised, and the production of which seems to be caused by presence of traces of alkali, the tungstic acid used was prepared by decomposing oxychloride with water and drying and igniting in platinum (contact with glass reduces some WO_3). The loss of weight on reduction in hydrogen and gain of weight on oxidation was several times repeated. The oxide was placed in a porcelain boat, being heated in a porcelain tube, and reduced in hydrogen and oxidised in a current of air. After each reduction the boat was found to be partially coated inside with a thin black film having a metallic appearance which oxidised completely when heated in air. A second boat was placed in the tube beyond that containing the substance for the purpose of ascertaining whether any metal was volatilised, but this boat was not found to become the least discoloured. The results of the determinations were as follows:—

	Grms.
1. Original weight of oxide	7·8840
2. Oxide after 1st oxidation	7·8806
3. ,, 2nd ,, ...	7·8792
4. Weight of metal, 1st reduction ..	6·2438
5. ,, ,, 2nd ,, ..	6·2481
6. ,, ,, 3rd ,, ..	6·2488

It is evident from these numbers that the 2nd and 3rd weights of oxide and the 2nd and 3rd weights of metal are the only ones which can be relied on as being perfectly pure. Taking the mean of these two series, we have 7·8799 grms. of oxide, giving 6·24845 grms. of metal, or 79·296 per cent. This corresponds to the atomic weight 183·84. In order to have obtained the number 184·00, the weight 7·8799 grms. of oxide must have yielded 6·24960 grms. of metal, differing by 0·00115 grms. from the experimental number.

2. *By Analysis of the Hexachloride.*—Perfectly pure hexachloride was prepared from the pure metal (itself obtained from oxychloride). No traces of oxychloride could be detected in the hexachloride employed, and it yielded a perfectly canary-yellow trioxide on treatment with water, showing absence of any pentachloride. In the determination of the chlorine, the substance was weighed in the piece of drawn-out combustion tubing, in which it

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* Read before the Manchester Literary and Philosophical Society, January 23, 1872.

was afterwards reduced in hydrogen, the hydrochloric acid being collected and estimated as silver salt. The determination of metal was made in a porcelain boat in which the weighed hexachloride was first carefully converted into trioxide by exposure for two days to a moist atmosphere, and afterwards reduced in hydrogen. Analysis gave—

	Grms.
(1). Weight of tungsten hexachloride taken	19·5700
,, chlorine found	10·4901
Percentage of chlorine	53·6050
(2). Weight of chloride taken	10·4326
,, metal obtained	4·83740
Percentage of metal	46·3680

Hence the atomic weight of the metal is 184·25 ; or, taking the mean of the two methods, we have 184·04 as the atomic weight of tungsten.

The author wishes to express his thanks to Mr. H. Rocholl, who has ably aided him in the above research.

RELATIONS BETWEEN THE ATOMIC HYPOTHESIS AND DISSECTED FORMULÆ.

By C. R. A. WRIGHT, D.Sc.,
Lecturer on Chemistry at St. Mary's Hospital.

To prevent misconceptions, permit me to supplement by some explanatory remarks the accurate, though necessarily brief, report of my paper on the "Relations between the Atomic Hypothesis and the Condensed Symbolic Expressions of Chemical Facts and Changes known as Dissected (Structural) Formulæ."

The propositions promulgated by Dalton are separable into two entirely distinct portions, viz., the *generalisation* that the quantitative compositions of compounds are expressible by assuming certain numerical values for each element, and taking simple integral multiples of these values to indicate the relative proportions in which the respective elements co-exist in given compounds (*e.g.*, assuming for carbon, oxygen, and hydrogen the respective numbers 6, 8, and 1, the composition of ethylene is expressed by 6 parts of carbon to 1 of hydrogen, and of marsh-gas 6 to 2×1 of hydrogen, of carbon oxide, 6 of carbon to 8 of oxygen, and of carbonic anhydride 6 to 2×8 of oxygen, and so on), and the *hypothesis* which furnishes a *raison d'etre* for this observed fact, viz., that elements are made up of atoms of the relative weights denoted by these numbers, compounds being aggregations of molecules each of which consist of small numbers of each component kind of atom ; 1 to 1, 1 to 2, 2 to 3, &c., respectively.

Although Dalton himself and many subsequent chemists may not have clearly discriminated between these two ideas, and may have regarded them as inseparably connected, yet the writings of chemists contemporaneous with that illustrious man clearly show that even in his day the distinction between the two notions was clearly made; thus Sir H. Davy rejected the hypothesis although he admitted the generalisation.* It is by no means clear that the "flood of light" which was let in on the mind of Berzelius on first hearing of Dalton's views was caused by the *hypothesis* ; the *generalisation* affording, as it did, the means of readily expressing in brief the complicated and apparently unconnected *percentage compositions* of different compounds previously in use, necessarily produced such simplifications as to render the hypothesis, which so elegantly accounted for the facts, doubly attractive ; nevertheless, the hypothesis was not universally accepted though the generalisation was beyond contradiction.

In the paper I have endeavoured to separate, as far as possible, the facts known to Dalton and discovered since his day, with the extensions of his generalisation (only applied gravimetrically by him) and other facts indicated by the symbolic system, the first germs of which (as a means of representing many facts in brief) he furnished, from the hypothesis which he laid down to account for certain of these facts and the subordinate hypotheses and postulates since added to it ; and so far from agreeing that the *hypothesis per se* has been the main cause of the rapid advances in chemical knowledge made since its promulgation, I am inclined to the opinion that the progress is almost wholly attributed to the *generalisation and the consequent establishment of symbolic representations of chemical facts*, which give to the intellect of the chemist an aid analogous to that which algebraic symbols render to the mathematician. The reason why the atomic hypothesis has been credited with being the source of such advantages is that fundamental facts, by reasoning on which the advances have been made, have been usually expressed in the language of the hypothesis ; but so far as the hypothesis is concerned, this is a mere accident, for it can hardly be doubted that the same conclusions would have resulted had the fundamental facts been expressed in other phraseology. In working out a mathematical problem the calculator does not mentally go through every link in the long chain of reasoning whereby every proposition may be proved from fundamental postulates ; he simply employs condensed symbols which refer to and involve these propositions : so the chemist in reasoning on the interpretation of new facts does not perpetually go back to his conceptions as to the ultimate nature of matter ; he only applies to the particular case certain generalisations drawn from past observations of facts, and summarised in symbolic forms.

The conception of material atoms associated with one another in different numbers, orders, and positions may, to some minds, appear a more satisfactory method of colligating facts than a system which simply uses certain conventional symbols to indicate these facts : so some minds are unable to grasp the notion that, for example, 6 and 8 are 14, without going through the mechanical process of counting on the fingers, &c., and to some the Euclidean demonstration that the cubic content of a cone is one-third that of the cylinder of the same altitude and on the same base, does not give any clear idea, whereas an experimental demonstration with water and cylindrical and conical vessels carries immediate conviction. That such mechanical notions are of a lower intellectual order than the abstract notions of numbers and their mutual relations requires no further illustration than the history of the terms *calculation* and *calculus*, which though now used in reference to purely intellectual processes of the highest order (aided by symbolic expressions) originally referred to the employment by barbarous notions of *calculi* or pebbles for the purpose of enumeration.

Admitting that the atomic hypothesis has directly on its own account, or indirectly by furnishing succinct and comprehensive language to express facts, done great service in the development of our present symbolic system and in the acquisition of knowledge, and that it affords a satisfactory explanation of several cardinal facts, and is in harmony with many physical generalisations (which is about the sum of what may be said in its favour), still these circumstances remain, that it is a mechanical conception suited, doubtlessly, to an age when an accurate knowledge of facts was only first beginning to exist, these facts being of a nature difficult to grasp without some material aid, but not possessed of such advantages when the knowledge of these facts and their correlations becomes somewhat more extended ; that it is unnecessary to express any facts, and incompetent (without much patching and botching) to explain many generalisations, where the measurement of force of some kind is a necessary datum ; hence the conclusion is drawn that it is undesirable

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* The distinction is clearly made in a "Chemical Catechism," by Thomas John Graham, M.D., second edition, 1829, this book being used as a text-book by students of that period in the Universities of Glasgow and Edinburgh.

that the ideas and language of this hypothesis should occupy the prominent and fundamental part in chemical philosophy now attributed to them.

Chemical Laboratory, St. Mary's Hospital,
February 10, 1872.

ON THE "CARBON CLOSET SYSTEM."*

By E. C. C. STANFORD, F.C.S.

I am induced to bring this subject specially before this Section because I consider its merits have never been properly brought under your notice and fully discussed. It has been so fashionable to consider the water-closet system as the perfection of sanitary skill, particularly among engineers, who generally look upon it as the *only feasible* means of house excreta removal, that it requires some hardihood for a chemist to urge here a totally opposite opinion. The fact is, however, that by putting this noxious and yet valuable material in the sewers the engineers have removed it from the power of the chemist to bring his science to bear on it. All proposals to deal chemically with the enormous dilution of town sewage have hitherto failed; nor, as far as we know, is there the least probability that anything effectual or profitable can be done in this direction.

Now I have always held that if we are to do anything to assist sanitary science we must begin with the noxious material at an earlier stage of excreta removal than as town sewage. Moreover, I consider that the system by water carriage is founded on error. To accomplish the required result an enormous proportion of water is necessary; no doubt it was at first supposed that this large proportion of water would oxidise and render innoxious the poisonous matter, but the contrary is now admitted to be the case—decomposition is rapidly increased and promoted. Moreover, the poison germs, so far from being destroyed, are diffused broadcast with appalling rapidity. In times of danger this becomes painfully evident; hence the *Times*, in a recent article on the expected cholera epidemic, raises an alarm in the following terms:—

"In the first place, the destruction of the excreta from cholera patients must be insisted on under the heaviest penalties, and a system of inspection adequate to enforce this provision must be organised. Without these preliminary safeguards we cannot hope to resist the enemy with any success. So long as the germs of the disease are allowed to pass through the sewers into the rivers, to be washed up by the tide against our seaside villages, to be wafted about our streets in the form of an impalpable dust, we cannot hope for any good results from sanitary measures of the ordinary kind. Cleanliness, ventilation—above all a pure water supply, are advantages which cannot be over valued. But until the germs of disease are systematically destroyed and excluded from any chance of mingling with the air we breathe and the water we drink, nothing will control the ravages of cholera. Every other precaution is subordinate to the main preventive measure, which it will need special powers to carry into effect—the destruction of the cholera germs before their diffusion."

The "sanitary deadlock" is sufficiently perplexing without this further complication; one authority obliging the distracted members of town councils to drain *somewhere*, another interdicting the drains from flowing almost *anywhere*; but none telling them *where* or *how* to dispose of their refuse. Now, however, the sewage question is to undergo another complication. The citizens of London, after paying so very handsomely for their grand experiment on main drainage, are to be told that, just when they most require it to purge their houses of poison and pollution, the mighty engine has broken down, and they must fall back on their own resources.

There can be no doubt the *Times* is quite right: the prohibition is absolutely necessary if the plague is to be stayed; but admit this, and the water-carriage system goes by the board, it must be condemned as unable to cope with the removal *under all circumstances* of house excreta.

In Glasgow, the Sanitary Section of the Philosophical Society, after two years' discussion, on which most of the members entered with strongly preconceived prejudices in favour of water carriage, a unanimous resolution was passed strongly condemning it, and insisting that in the perfect system of the future all fœcal matters must be rigidly kept out of the public sewers.

It is a compliment to the intelligence of that resolution to find that public opinion is gradually working round in the same direction. The city of Glasgow may not have been so far wrong after all in watching and waiting the experience of the great city before committing herself to a proportionately costly scheme. At the time the resolution I refer to was passed, the water-closet at one end and irrigation at the other were generally considered the two *necessaries* to all civilisation. We have lived to see that neither of these are necessaries, and that neither are generally applicable or advantageous. We are told now that successful irrigation must be accompanied by processes of deposition or filtration. The British Association Committee even recommend two separate systems of drainage, and this partly concedes what the resolution referred to demands. I would, however, go further, and treat the house excreta as a material the removal of which should have no connection whatever with the sewers and should never be mixed with water; in fact, that the sewage system should not be complicated by this, the main source of the worst pollution.

Now I affirm that in the most populous cities the general use of the carbon closet system is perfectly practicable, and that it must be by far the most healthful and by far the most profitable means of getting rid of the nuisance.

In this Section last year I heard a gentleman say that "no scavenger should ever visit his house." Now I should like to have asked how that gentleman disposed of his house ashes, because either he allowed the scavenger to call for them, which disproved his assertion, or he put these into the sewers, in which case some other local authority ought to look after him. This, however, is not an uncommon feeling of repugnance on the part of the householder, and must be duly respected; yet the most prominent advocate of water carriage must draw the sewage line somewhere, and all would draw it outside of house ashes. These must not in any case find their way into the sewers. But in the more noxious and more valuable material we actually have much less to remove, and the removal can be made equally inoffensive. I admit that any system to be generally adopted must require no attention from within and must be quite as automatic as the water-closet. This, however, is easily arranged, and if one tithe of the talent and ingenuity had been spent on the dry system that has been lavished on the wet, it would, I believe, have long ago superseded it in this country. There is no more necessity for a scavenger to enter a house properly arranged on the dry system than on the other.

Let us consider, in the first place, what is the actual total amount of excreta per head to remove; and I wish to premise that I would advocate no system that was not intended to cope with the whole of the house excreta, solid and liquid, leaving only the wash-waters to enter the ordinary drains.

I have published a table, taken from various authorities, showing the estimated amount of this material to be removed per head, with its value.* The last table are

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* Read before the Mechanical Section of the British Association at the Edinburgh Meeting.

* Chemical News vol. xxii., p. 302.

the figures employed by Her Majesty's Commissioners on the Pollution of Rivers in their reports, and as they make no allowance for loss, for absence from home, &c., I think the average of 8 cwts. (including only about ¾ cwt. solid excreta) per head may be fairly taken; so that in a large household of ten persons it would amount to 80 cwts. (about 8 cwts. solid), and its chemical value would be about 80s., or 8s. per head. The same household would use at least 20 tons of coals, and probably send away 4 tons of ashes. The total annual quantity of charcoal required therefore could not exceed 4 tons, would probably be much less, and the whole removal, allowing for the drying action of the charcoal in the vault, would be about 5 to 6 tons weight.

Eight cwts., then, is the total quantity to be annually removed per head, and it is now generally effected by mixing it with about 1200 tons of pure water, all of which it renders highly offensive, and its value, however it may be extracted, if that be indeed possible, is reduced to very much less than this, over and above the dilution, in inverse proportion.

It is scarcely necessary to reiterate the disadvantages of this method of removal. We know that the closets are costly in erection and in repairs, that they consume and foul a large portion of our water supply, and that they have hitherto wasted the whole of the material. We first tried to confine the polluted water in cesspools, then we converted these into a network of deep laid sewers, thereby connecting all the houses and insuring the spread of a cholera or typhoid fever epidemic. We do not know yet how to deal with the sewer gases, and have discovered no certainly perfect method of getting rid of the pollution. Now it does appear to me that we have mistaken the application of water; we do not require such a gigantic carrier and diffuser. Knowing how possibly dangerous the excreta may become, we ought to seek a disinfectant which will add as little as possible to its bulk and increase its manurial value. Therefore I would at once add that precisely the same objection may be urged against the use of earth, which would require three and a half to four times the quantity of the material removed, and reduce the value of the manure to even less than this in inverse proportion. The analyses of earth-closet soil by Dr. Gilbert confirm my views as to the poverty of the manure. The same applies more forcibly to the use of ashes, of which even more are required. These two materials act only as deodorisers so long as they are dryers; let the mixture become damp, and it at once becomes offensive. The use of earth in large cities must be impracticable and will always be expensive. Ashes can generally be provided in the house, but these are not so good as earth, and the manure is scarcely worth removing. In all the towns referred to in the British Association Committee's reports where this system is adopted the price obtained is merely nominal.

In discussing the merits of a dry system, we have always this advantage over the advocates of the wet system, that, while they are limited to the use of water, we have a large choice of dry deodorisers. That which promises the greatest success is charcoal, and this is now being made the subject of experiment on a pretty large scale. There is no greater difficulty than to provide closets for workmen which shall always be perfectly inoffensive and shall not get out of order. I can point out one work where the system I advocate has been in use for three years by 150 men, and the closets have never got out of order. We have never worked with more than a fourth the quantity as compared to earth, and I am convinced that we may reduce the amount required even to one-eighth. I have assumed, however, that we use a weight equal to the material to be removed.* The house may have a closet on each floor—say three, or even four; these are arranged one over the other. Each draws on the same supply of charcoal at the top of the house; the contents of the closet are allowed to fall through a 12-inch thin galvanised iron pipe into a water-tight cemented cesspit in the basement of the house. The charcoal reservoir is filled and the cesspit emptied by the scavenger once a year, the whole process being quite external to the house. The urine is emptied into a simple earthenware urinal in the closet on each floor, and it falls through a lead pipe direct into the pit, where there is always sufficient excess of charcoal to perfectly absorb it. The total absence of all odour is most remarkable. No water-closet can be compared to it. The quantity to be removed is reduced to less than twice the weight of the total excreta, and when removed an ordinary observer would scarcely know it from the original charcoal employed. The next step in the process is to remove it to the chemical works, where it is re-burned in iron retorts, the ammonia distilled off, and the charcoal returned to the householder. In small villages, one of the retorts at the gas-works will get through a large quantity, and the ammonia will add to the value of the gas-liquor. There is a constant increase of charcoal obtained from the excreta itself; this is an animal charcoal similar to that from bones; it contains the whole of the phosphates and the potash, and with the ammonia is available for manure.

The chemistry of the process has been so fully gone into before, on a former occasion, in another section, that I deem it unnecessary to refer further to it here; it will be found very fully described in several papers already published in the Chemical News.* I wish here to show how capable the process is of general extension. It is scarcely necessary to assure you that the cholera germs cannot survive the ordeal by fire which they suffer in this treatment. If, however, in case of cholera, further disinfection be desired, it can easily be effected when the whole excreta of the house is in a small pit, and in any case it is removed from our neighbour's contamination. A remarkable proof of the wonderful freedom from odour is described in a former paper.†

The process is now being worked by a small company, called the Nitro-Carbon Manure Company, Limited, established by a few gentlemen to show that the process, even on a comparatively small scale, can be made a commercial success; all are satisfied as to its perfectly fulfilling all sanitary requirements. Several of the principal shipbuilders on the Clyde are erecting the necessary closets and urinals in their yards, and in a few weeks these will be used by about 10,000 men. In re-burning the material the retorts to be employed will be Norman's patent twin rotary retorts, now much used in the principal sugar houses in Glasgow. An arrangement has been made with the shipbuilders to allot them shares in the Company to the value of the closets erected, and thus these employers of labour will share in any profit which may be made. If the process pays as well as we expect, it must rapidly extend; but as I know you will deem it your duty to examine every possible solution of the sewage difficulty, I make no apology for bringing it under your notice at this stage. Now, in estimating the profits of any chemical process as compared with irrigation, it is quite proper to value the manure produced only by chemical analysis. Her Majesty's Commissioners adopt this course; they attach little importance to farmer's certificates, but value entirely by chemical analysis. This is the only fair way, because it shows exactly what it is worth in open market; and, valued in this way, all the manures produced by the several sewage companies are comparatively worthless. Yet, although this has been abundantly proved, why are the shares at such a premium? But in comparing the value of irrigation with that of any chemical process dealing with sewage, they bring in another and, I submit, an improper

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* The remarkable drying action of the charcoal before alluded to was singularly shown in one house, where the contents of a wash-basin had been daily emptied into the urinal and found its way into the vault for twelve months before it was accidentally discovered. The manure, when removed from the vault, was apparently quite dry.

* Chemical News, vol. xix., pp. 253, 269, 291; vol. xx., p 196 and vol. xxii., pp. 289 and 301.

† Chemical News, vol. xxii., p. 303.

element, *i.e.*, the total profit of the farmer. This is unfair; the farmer buys his manure—say, made from bones, or, say, from excreta—by analysis at its market value, and his living is made out of what that investment produces from the land. The irrigationists have no right to put themselves in his place, reap his profits, charge themselves nothing for the sewage, and call that "making it pay." In one of the accounts quoted in Her Majesty's Commissioners' Report, the "right of shooting over the farm" is actually entered as an irrigation profit!

We have hitherto used the ordinary earth-closets of Moule's patent, simply throwing smaller charges of charcoal in coarse lumps; these have been wonderfully successful, but in order to use fine granulated charcoal, and to considerably lessen the quantity required, it was necessary to invent a closet for this special application. I applied to my friends, Messrs. Pollock and Pollock, engineers, of Leeds, and the closet exhibited is the result of their ingenuity.* It delivers a minimum, but accurately measured quantity, and places it exactly where it is required; and it is remarkable what a small quantity of the deodoriser is sufficient to keep the deposit perfectly free from odour.

I exhibit also the plans for workmen's closets; and when I add that in all the yards where these are being erected they are to supersede large and expensive ranges of iron buildings and water-closets, you will understand that their great advantages have been already proved to the satisfaction of those pioneers of successful engineering, the shipbuilders on the Clyde. The impossibility of stopping their action and rendering them offensive is highly important. An instance of the extreme difficulty of dealing with factories is mentioned in a former paper.† The almost universal experience is that the water-closet is unsuitable for factories. But owners of private houses are beginning to think in the same direction, or why do we so constantly find disinfectants still employed? If the water system is or can be made perfect, why should such agents ever be required? These disinfectants have all, more or less, a disagreeable odour, are all expensive, add nothing to the value of the product, and confess the weakness of the water-closet system.

I think, therefore, the method of the future must be some such modification of the dry process as that now referred to as the carbon closet system.

ACTION OF NITRIC ACID ON CHARCOAL.

(Preliminary Notice).

By ANDREW SCOTT.

In consequence of a paragraph in the Chemical News (vol. xxv., p. 21), taken from the *Scientific American*, announcing that Professor Schulze had succeeded in oxidising charcoal with permanganate of potash, obtaining thereby oxalic acid and a number of interesting products, I beg to give notice that I have spent a portion of my leisure for the last few months in examining the action of nitric acid on charcoal from various sources, and that I have obtained a compound containing over 30 per cent of carbon, 2 to 3 per cent of hydrogen, the remainder being chiefly nitrogen. It is a black amorphous substance, very soluble in water, alcohol, ether, &c. It is very deliquescent, absorbing 20 per cent of its weight of water in a few days, and becoming a dark liquid, the water being again expelled in a short time at the temperature of the water-bath. When heated on platinum foil it takes fire, the combustion spreading rapidly through the mass. Heated in a test-tube it melts, swells considerably, and gives off nitrous fumes. It combines with alkalies, and the solutions give precipitates with most of the metallic salts. Its watery solution is also precipitated by hydrochloric and sulphuric acids. I have prepared this body from willow charcoal, coke from crude paraffin oil, bone charcoal, and from mineral charcoal found in ordinary household coal.

I would have had the analysis of this substance finished by this time, but for the circumstance that it requires a most unusual length of the combustion tube to be filled with copper turnings, a fact which was only apparent on attempting to estimating the nitrogen, after losing some weeks' work on the determination of the carbon and hydrogen.

Addiewell Chemical Works,
February 5, 1872.

NOTES OF DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

X.

Entering the duodenum in conjunction with the pancreatic juice is the bile, a secretion very complex, and in its morbid states causing much trouble and suffering. It has the constitution of a soap, and serves as an excretion as well as secretion; the liver is the gland which is actively engaged in its separation.

Bile consists of glycocoll and taurine combined with cholic acid, and these again combined with soda, forming glycocholate and taurocholate of soda; there are certain of the true fatty acids in the bile, as palmitic and stearic. The cholochrome or colouring matter of the bile consists essentially of two parts obtained by decomposition, cholochloine and cholophæine.

Cholesterine is abundant in the bile, mucus is also present from the bladder, phosphates of lime and magnesia also exist with other salts, and a trace of copper is found in the ash.

The bile is neutral or alkaline; on standing it decomposes and gives an acid reaction, the taurocholate of soda being decomposed into cholate of soda and taurine, the glycocholate of soda into glycocoll and cholate of soda. On further decomposition the acidity becomes more marked from the development of valerianic acid; the cholate of soda is broken up into cholic acid, which precipitates, and a new salt is formed from the soda and valerianic acid. Cholochrome is also deposited, and the glycocoll yields acetic acid and ammonia.

The purified ox-bile of the pharmacopœia is prepared by precipitating the mucus with rectified spirit, and drying the clarified fluid by evaporation.

Bile acts as a natural purgative, is powerfully antiseptic, and emulsifies the fatty portion of food. The cholesterine of bile frequently separates, forming gall-stones, colouring matter generally being contained in them; cholesterine is freely soluble in hot alcohol, but crystallises out on cooling.

The colouring matter and the biliary resins are often present in secretions as morbid products, and two tests have been devised for their identification. If cholochrome be suspected, take a few drops of the fluid and place them on a porcelain dish, to this add a few drops of hydric nitrate (HNO_3); a play of colours gradually takes place when this body is present, known as the chameleonic changes. The biliary resins also undergo a colour change when a portion of syrup is added, and then a few drops of sulphuric acid. I always find it best to mix the bile and syrup in one test-tube, and pour it on to a few drops of the acid at the bottom of another; this is known as Pettenkofer's test.

Space will not allow us to enter into a discussion on the various theories of bile formation, &c., but they will be considered elsewhere.

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* This closet can be obtained of the Carbon-Closet Company, 46, Naymount Street, Leeds. It was figured in the *Engineer* for August 5, 1871.

† Chemical News, vol. xxii., p. 302.

ON THE MANUFACTURE AND REFINING OF SUGAR.*

By C. HAUGHTON GILL.

(Continued from p. 54).

The juice, therefore, has now been defecated, carbonated, sent up stairs, heated to boiling, so as to decompose any remaining bicarbonate of lime in the solution, and to raise its temperature, so that the charcoal may have a greater action upon it, and it has then been allowed to run down through a column of animal charcoal 15 or 18 feet deep. The thin juice, as it is now called, issuing from the bottom of the charcoal, has become decolourised, somewhat freed from the lime, and from the gummy and albuminous bodies which the lime had failed to remove. The next process is to concentrate it, or to remove from this thin juice—and, as a rule, it is very thin—a great portion of the water which it contains. This is effected in the ordinary way by boiling.

In the older processes this was done by simply putting the juice into open pans, aud putting a fire under them, in the same way as cane sugar is treated, but this method is no longer adopted. It is now done in an apparatus, which I may call a double effect apparatus, because the heat is used twice over, for the purpose of evaporating the liquid. The juice is put into a vessel somewhat resembling a locomotive boiler, being heated by steam, which passes into a number of pipes which run through the boiler, while a very partial vacuum is created above. When the steam is hot enough to make the liquid in the vessel to boil rapidly it goes off in steam, but instead of sending it out into the air, and wasting the heat contained in this vapour from the boiling juice, it is made to pass by a tube into the tubes of the second vessel similar to the first, and though the temperature of the vapour thus obtained from the first pan is not high enough to make the liquid in the second vessel boil with any degree of rapidity at the ordinary atmospheric pressure, by connecting the top of No. 2 vessel with an air-pump, and a condensing apparatus, so that the contents of the second vessel boil much below the usual temperature, this slight difficulty is entirely got over, and thus nearly the whole of the heat given off by the steam is utilised. If the steam coming from the original boiler were capable of evaporating, say, 10 lbs. of water out of the first vessel, theoretically, if there was no loss of heat, the vapour from the juice in that vessel should, on passing into the second vessel, be also capable of evaporating another 10 lbs. there, but practically it does not do anything like so much work; but still there is a considerable saving of fuel by employing two vessels connected in this way. In some factories three such evaporating vessels are connected together, but I believe the saving effected by using a third is very small, because the practical loss of heat is very considerable.

In this double effect apparatus the juice is brought to what is technically termed 25° Baumé, which I may explain thus. I will put into this jar some water, and I then put into it a little apparatus called Baumé's areometer, which, when immersed in water, sinks down until the top of the graduated scale is just on a level with the water in the jar. Now I will mix with the water some sugar, and we shall find that the liquid has become heavier, bulk for bulk, than the water, and in consequence the float will not have to sink so far into it in order to displace a quantity of the liquid equal to its own weight, but will float higher out, and higher in proportion as there is more sugar in the liquid. This is the kind of instrument which is constantly used in sugar factories to roughly determine the strength of the various solutions of sugar. When the juice is so far concentrated that this little float only sinks in it so far as the mark 25, it contains about 45 per cent of its weight of total solids, including sugar, in solution. From this preliminary concentration, the juice, now technically "thick juice," goes to a cistern in which it is heated to boiling, and is then again filtered through fresh animal charcoal, to remove more of the colouring matters still present, and some of the albuminous bodies which are more readily absorbable from dense than from thin liquids. After this second charcoaling, the juice is almost colourless, and very brilliant and transparent, but is still not a pure or by any means a saturated solution of sugar, and, accordingly, before the maker can obtain any sugar from it in the solid form, he is obliged to reduce the quantity of water still further. This he does by the use of the vacuum pan, the name of which, I have no doubt, suggests the nature of its construction. It is simply a pan, into which the liquid can be introduced and heated, while a comparatively perfect vacuum is formed above the surface, and in which, consequently, the liquid is capable of boiling at a very low temperature. [The lecturer then described, by means of a large diagram, the construction of the vacuum pan]. The liquid introduced into this vacuum pan of course loses water and shrinks, and from time to time more is added, until the pan is filled to a convenient height with the new and more concentrated liquor. At this point the admission of liquid is stopped for a short time, and the boiling is continued, until a sample, taken out by means of what is called a proof stick, is found to be of a certain degree of stickiness. At this time the liquid contained in the pan is a supersaturated solution of sugar—that is, a solution containing more sugar than the water present really ought to contain at that temperature. The problem which the man has to solve is, how to disturb that liquid in such a way as to bring about crystallisation. I showed you, by some experiments at our first meeting, that all supersaturated liquids cannot be disturbed in the same way. A solution of sulphate of soda might be disturbed in such a way as to promote crystallisation by merely shaking it, but one of hyposulphite of soda might be shaken vigorously without starting crystallisation. The problem, therefore, is how to start crystallisation in this supersaturated solution of sugar, at this comparatively high temperature, for, although it has boiled at a comparatively low temperature, it is still much hotter than an unaccustomed hand could bear. The right kind of disturbance in this case is, as a rule, to admit by little jerks small quantities of the liquor from which the boiled mass was made. The man, therefore, opens the cock, and lets in a small quantity of the thickened juice into the pan, and after a little time—the duration of which appears to me very uncertain, depending very much on the purity of the juice operated upon—the boiler, when he takes out the proof and examines it between his eye and the light, sees small grains of sugar beginning to appear. At this point he knows that crystallisation has begun, and when it has once started it proceeds very rapidly, and in a few minutes after they have once made their appearance, the whole mass of liquid in that pan is filled with a mass of very minute crystals of sugar floating in a syrup, which is a normal saturated solution for the temperature at which the crystallisation takes place. The excess of sugar forming the supersaturated solution is deposited, and we have now crystals floating in a solution only properly saturated for the temperature at which we have been operating. After the crystals have once formed, and we have this mass of crystals in the pan, little by little, more of the original solution is admitted, and so it is continually added and the water is evaporated until the pan becomes nearly full. The effect of doing it is this. As we admit a fresh portion of liquid into the pan, and evaporate off the water, the sugar crystallises out at once; it no longer forms a supersaturated solution, for we have present a great number of crystals on which it can deposit. The crystals which are first formed now continue to grow by [illegible] continuous addition of sugar to

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* The Cantor Lectures, delivered before the Society of Arts.

their surfaces, and if this operation of adding to the solution of sugar and evaporating off the water be allowed to take place a sufficient number of times, and in a sufficient gentle manner, the crystals will become a very considerable size. I have here some samples of sugar made by this process, some of which are very fine specimens. Here is some of very nearly the first quality beet-root sugar, which is made in France in the way I have described. It has been boiled for twelve hours in this way. After they once get "grain," as it is technically termed, in the pan, they add fresh liquor in very small quantities, and evaporate off the water, so that there is a slow deposit of sugar on the grains already formed, so slow that it deposits in a comparatively regular manner, and when that occurs we get large-sized crystals. Here are some still finer, for which I am indebted to Mr. Duncan; indeed, it is the finest I have ever seen, though it is called raw beet sugar. It is made in England, from English-grown roots.

We understand now what has occurred in the vacuum pan. We have a mass of sugar crystals floating in a syrupy material, which consists of some water, a good deal of sugar, and all the impurities which the juice originally taken into the pan contained, because when crystallisation takes place, the crystals formed consist of only one kind of matter; therefore, as a rule, the crystals formed in this case are practically pure sugar, and, therefore, what is left behind when the crystals are separated out must contain all the impurities originally present, plus so much of the sugar as has not been crystallised on account of the water still present. The mass in that state, when the boiling is finished, is let out by opening a plug or slide valve in the bottom of the apparatus. I cannot show you a mass actually so formed from beet-root, because there is no beet-root factory in England in which they work exactly in the way I have described, and where they make these crystals from beet-root; and even if I could show you some of the mass as it comes from the pan, it would present a different appearance when exhibited to you from what it does when first drawn off, because it is then hot; and when it is cold, as it would be here, some of the sugar which the syrup contained when hot would be deposited, and would cement the crystals of sugar together, so that the mass would be somewhat hard. I have, however, prepared here what is not a bad representation of a mass as it comes from the pan, only I have rather too large a proportion of syrup. It is prepared by mixing some of the beet-root sugar crystals in an impure syrup. It is a hard sticky mass, which does not look a very promising material from which to extract pure white sugar. The sugar now has to be recovered from this, The old method was to put the mass into moulds of some kind, at the bottom of which holes could be opened, so that the syrup could gradually drain away and leave the crystals above, but that is a very slow process, and the syrup which actually adheres to the crystals is much more sticky than that which I have here. It therefore drains away very slowly, takes a long time in operation, and is, after all, very imperfect. It is necessary, therefore, for the rapid success of the operation, that we should employ some force to aid the draining of the syrup, and the mode usually adopted is to make use of a so-called centrifugal machine. You know that when anything is set rotating very violently on its axis, the outer particles of it at any portion of their course tend to continue their motion in the direction of a tangent to the circle at that point, and if you make the motion very rapid, the force which makes them tend to fly off becomes very considerable. I have here, owing to the kindness of Messrs. Wainwright, a model of a centrifugal machine, such as is actually employed. It consists of an outer casing of iron, inside which there is a drum strongly made, the sides of which consist of finely-perforated copper, or in some cases of woven wire, but at any rate it a pervious coating. Liquids are capable of passing through that coating, but solids are retained in the meshes. I will now pour in some of the mixture of syrup and beet crystals to the drum; and, while it remains at rest, very little, if any, will pass off. There is an opening in the outer casing, through which the liquid which passes into it may drain away conveniently. On setting the drum in motion you will find that the mass which was lying at the bottom becomes separated by the centrifugal motion and spreads itself up the sides of the drum, and as the motion is continued the liquor passes through the meshes, and the sugar is becoming quite white. The syrup is now running out very rapidly, and on increasing the speed of the drum, the sugar is spread evenly round the sides. When it is going at its highest speed I will dash on it a little water, which will be forced out through it and will slightly wash it, and thus help to carry away the last particle of syrup which might otherwise be left behind. On stopping the action, I can now scrape with my hand enough of the sugar to show you the nature of the operation that has taken place while the syrupy portion has drained away beneath.

In this way, and in this first operation, about three-fourths of all the sugar that can be obtained is obtained if the process is conducted successfully. The syrup that has drained away is obviously worth keeping. It is a saturated solution of sugar, and for every pound of water we have there we have at least two pounds of sugar, for one pound of water will dissolve that quantity of sugar. It is obviously necessary to recover as great a quantity of that sugar as possible; the syrup is therefore treated in the following way:—The principle is very simple, although the details of the process are somewhat complicated. The solution is concentrated to a convenient point, and allowed to stand for a considerable time. It is concentrated in a vacuum pan, similar to that I have described; but it is found on the second concentration that you are no longer able to get grain formed in the pan. If the original solution or liquor is very impure, it is much more difficult to disturb that state of supersaturation than if it is comparatively a pure solution of sugar. Now this syrup that has been drained away is far more impure than the original thickened juice which we evaporated, and, accordingly, it is not possible to get crystals of sugar formed in the pan during this second concentration. But the liquid having been thickened to the degree which experience has found necessary, is run into large iron tanks, where it is allowed to stand for a fortnight or three weeks, and kept at a moderately high temperature. Crystallisation then slowly takes place, and the mass is then stirred up with some fresh syrup, and put through the centrifugal machine again. This constitutes the second product of factories, of which I have two samples here. The result is, of course, less pure, both in appearance and in reality, than the first product, owing to the crystals retaining on their surfaces a large proportion of the still more sticky mother-liquid than the first did, and not only a larger proportion of that, but this mother-liquid itself is more impure; consequently the whole mass contains a much greater proportion of impurities than the first crop. The syrup from this second product is again concentrated, but by this time it is so impure that before crystallisation can be brought about after it is concentrated, it has to be kept for six months in tanks at a comparatively high temperature. At the end of that time, a comparatively small quantity of sugar has deposited out. Some of such sugar I have here, but I am bound to say it is the worst I ever examined. It looks very nice, but if there are present any persons practically acquainted with sugar, they will be surprised to hear that it contains over 9 per cent of salts, although it is an apparently bright, and what is technically termed "free" sugar. This leads me to mention very briefly the fact that, if in a concentrated solution of sugar you have various other matters, if you only give it time enough, it will crystallise out in actual chemical combination with some of these salts, and, consequently, this third product, which stands a long time, and which is formed from the mother-liquid containing a large proportion of impurities, is not merely pure sugar coated with impure syrup, but is actually an impure product, itself also coated with syrup, and is, consequently, often very much contaminated with salts.

The syrup which drains away from the third product has no longer any value to the sugar-maker, but is sold for the purpose of making spirits from. It is diluted, fermented, distilled, and thus is obtained a crude beet-root spirit, which is afterwards rectified, duly flavoured, and sold as French brandy.

(To be continued).

NOTICES OF BOOKS.

Spectrum Analysis in its Application to Terrestrial Substances, and the Physical Constitution of the Heavenly Bodies. Familiarly explained by Dr. H. Schellen, Director der Realschule I. O. Cologne, Ritter des Rothen Alderodens IV., K.L., &c. Translated by Jane and Caroline Lassell. Edited by William Huggins, LL.D., D.C.L., F.R.S. London: Longmans and Co. 1872.

This admirable work does credit to, or should we say is worthy of, the author, the translators, and the editor; while their endeavours have been ably carried out by printer and by publisher. The first part treats on the artificial sources of high degrees of heat and light; the second on spectrum analysis in its application to terrestrial substances, while the third is devoted to spectrum analysis in its application to the heavenly bodies. There are three appendices, "On the Cause of the Interrupted Spectra of Gases," by G. Johnstone Stoney, M.A., F.R.S.; "Preliminary Catalogue of the Bright Lines in the Spectrum of the Chromosphere," by C. A. Young, Ph.D., Professor of Astronomy in Dartmouth College, and a list of works and papers on spectrum analysis. We must approve the method followed in the translation and by the editor. In many translations the views of the author are supressed in order that the views of the translator or editor may be expounded; but here Dr. Huggins, however leniently such a fault might have been looked upon with him, has permitted the author's views to remain intact, clearly stating his own and wherein lies the difference. Thus the uninitiated are imperceptibly led into a course of reasoning that affords infinitely better tuition than would be obtained by whole reams of mere description.

Spectrum analysis, with regard to terrestrial substances, has been so fully gone into in these pages that we cannot, without repetition, submit an extract interesting to our readers, and the spectra of the heavenly bodies do not fall within the scope of this journal. But we none the less heartily refer our readers to the work.

The original in the German includes a table of spectra, Kirchhoff's maps, plates of the total solar eclipse (1868, India, and N. America), the solar spectrum of the prominences during a total eclipse, the solar prominences observed by Zöllner and Young. To these the translators have added Angström's maps of the solar spectrum, the corona photographed at Syracuse by Mr. Brothers, and the solar prominences observed by Respighi; while the subject-matter is illustrated with many well-executed woodcuts.

Memoranda on Poisons. By the late Thomas Hawkes Tanner, M.D., F.L.S. Third and completely revised edition: Renshaw. 1872.

The editor of this well-known and useful little book has been wise enough to perceive that its chief value is for students. He has adopted a new and more sensible classification of poisons, and has evidently taken great pains in the selection of the best methods of testing for such. The medical bearings on this subject are also treated with great clearness and succinctness. Nevertheless, although the book will be found useful by many practitioners, the analytical details are, of necessity, far too brief to render it a sufficient guide for the practical toxicologist. For the student, on the other hand, it is thoroughly well adapted, as it contains all he is required to know, even for the lengthy examinations, without containing more than he can easily master.

CORRESPONDENCE.

LOSS OF SODA IN LEBLANC'S PROCESS.

To the Editor of the Chemical News.

Sir,—In your issue of the 2nd inst. (vol. xxv., p. 54) is an abstract of a valuable paper, read by Mr. James Mactear before the Glasgow Philosophical Society, "On the Loss of Soda in Leblanc's Process." As the results obtained by this gentleman differ in many respects from those formerly obtained* by myself (as pointed out by him), permit me to discuss some of the reasons for these differences.

In the matter of the loss caused by the formation of insoluble sodium compounds left behind in the waste, Mr. Mactear considers 5·44 per cent of the sodium employed as sulphate (the number I obtained as an average of about ten months' production in an alkali works in the Lancashire district) to be "exceptionally high." During the last two years I have been enabled, through the kindness of Mr. I. Lowthian Bell, to make some observations on the amount of insoluble sodium compounds contained in the waste of an alkali works in the Tyne district, where chalk is used in the balling process; and though these experiments were not carried out with any degree of minuteness, still they indicated a somewhat less loss than that in the Lancashire works, where limestone was used, viz., about 4 per cent as against 5·44. On the other hand, M. Scheurer-Kestner (Chemical News, vol. xxii., p. 267, from *Comptes Rendus*, June 20, 1870) concludes, from his own experiments, that the loss from this cause "certainly is never less than 5 per cent, and often very much larger." I am disposed to think that the insoluble double compounds are mainly calcium-sodium carbonate, formed from the excess of caustic lime in the black ash during the lixiviation; and hence the proportion of limestone or chalk and its physical character will greatly influence the result. The latter substance is likely to mix better with the fritted ash materials, and the ball soda produced will contain fewer "plums" or lumps of more or less cauticised calcium-carbonate disseminated through the mass.

As to other sources of loss, it is expressly stated in my paper that the capabilities of production of the plant were strained to the uttermost during the period of experiment, so that the losses observed are probably the maxima consistent with remuneration; thus the high percentage of $NaCl$ in the salt-cake is accounted for, likewise that of unchanged Na_2SO_4 in the black ash. As regards the former point, I may observe that 5·31 was the average of undecomposed $NaCl$ in the materials employed in the balling process, including salt-cake of inferior or damaged kinds, imperfectly furnaced, and containing large quantities of $NaCl$, from the circumstance that the nitre-cake (impure $NaHSO_4$) was mixed with a large excess of salt, and roasted—a proceeding which is rarely effectual in destroying all the acidity of the nitre-cake, and always risks the employment of too much or too little salt. Salt-cake of average quality from the salt-cake furnaces alone contained much less $NaCl$ than this average—viz., about 3 per cent only or less. This little circumstance just shows the extreme difficulty in obtaining correct data for calculation in such cases; in fact, without an enormous amount of personal labour on the part of the experimenter it is impossible, as the samples taken by workmen cannot be relied on as representing the true average.

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* *Journal of the Chemical Society*, 1867, 407.

Two circumstances may possibly concur in making Mr. Mactear's results appear higher than mine. In the first place, it is usual in alkali works to assume the combining number of soda as 32 instead of 31 ($O=8$), and if the standard acid employed be graduated in one way, the result is that 31 parts of available soda are counted as 32, making an apparent increase in the yield of 3·2 per cent. Sometimes, however, the acid is graduated on the supposition that sodium-carbonate contains 59·26 per cent of Na_2O ($Na=24$) instead of 58·49 per cent ($Na=23$); if this method is employed, the results come out 1·4 per cent too high. In reference to this point, I may here reiterate that I have never known an instance on the west side of England where soda-ash invoiced at 48 per cent, and reported at such a percentage by trade analysts, actually contained more than 46·5 per cent of compounds capable of neutralising sulphuric acid, and calculated as Na_2O; the amount of available soda contained being frequently even below this.

In the second place, ordinary soda-ash contains a small percentage of calcium-carbonate, and frequently a somewhat considerable one of aluminate of sodium; the CaO and Al_2O_3 of these compounds neutralise acid, and are reckoned as Na_2O (as is also the Na in sodium-silicate, sulphite, and hyposulphite, which are usually present in soda-ash, but are of questionable value to the consumer). It is probably not beyond the mark to suppose that 1° of the percentage estimated by test-acid is caused by the presence of CaO and Al_2O_3; this amounts, in the case of a 48 per cent ash, to 2·1 per cent on the available alkali present.

In my estimations both these sources of error were carefully guarded against. Assuming them both to exist to their probable maximum amounts, it is evident that a loss of $3\cdot2+2\cdot1$, or upwards of 5 per cent (1 cwt. per ton), of sodium might exist in the manufacture, which would not be revealed to the manufacturer by his book of "returns;" from instances that have come under my own observation, I have no doubt that in many alkali works losses exist to even greater amounts than these of which the manager is entirely unconscious.

Mr. Mactear's quoted numbers ("100 parts of common salt gave 86·318 parts of ash of 48 per cent strength") only bear out his calculation on the assumption that 100 parts of salt should, theoretically, yield $\frac{86\cdot318}{85\cdot91} = 100\cdot47$ parts of ash at 48 per cent, which necessitates that the salt should contain 9 per cent of water and other substances. One hundred parts of pure NaCl would yield $\frac{31}{58\cdot5} \times \frac{100}{48} \times 100 = 110\cdot4$ parts of 48 per cent ash; but if 9 per cent of the body used were not NaCl, the theoretical yield would be $\frac{91}{100} \times 110\cdot4 = 100\cdot464$ parts of 48 per cent ash. The determination of the actual *average* amount of water in large quantities of damp salt exposed to drying and wetting agencies of transit, weather, storage in warm or moist places, &c., is a matter of great difficulty, if not impossibility, but indispensable when the calculations are made out "per salt decomposed;" if the salt operated on had been pure NaCl, the total loss would have been $\frac{110\cdot4 - 86\cdot318}{110\cdot4}$, or 21·8 per cent, so that it is evident that an error in the determination of the average moisture in the salt used vitiates the whole calculation.—I am, &c.,

Charles R. A. Wright.

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MISCELLANEOUS.

Xylol.—This hydrocarbon is likely to become of great importance, if its application in cases of small-pox is really followed by such good results as have hitherto been obtained at Berlin. The Berlin *Klinische Wochenschrift* states that Dr. Zuelzer, Senior Physician at the Charité Hospital, had there administered xylol in cases of small-pox, with the most comeplete success. It is given in doses of from 3 to 5 drops for children, 10 to 15 drops for adults, every hour to every three hours. It is harmless, because as much as a teaspoonful at a time has been taken. The most convenient form of taking it is in capsules, as already supplied by a Berlin firm, and containing 3, 5, 8, and 12 drops each. The specific action is not yet clearly defined, but early information on this point is promised. The theory at present is that xylol is taken up by the blood, and acts as a disinfectant. The absolute purity of the xylol is important, as toluol and other analogous compounds do not possess this peculiar action, and it seems there are some practical difficulties in obtaining xylol absolutely pure. Xylol, or xylene, C_8H_{10}, was first separated from coal naphtha by Dr. Hugo Müller; it is obtained by fractional distillation until a distillate is obtained of about 140° C. boiling-point; this is mixed wlth sulphuric acid, which dissolves xylol, forming xylol sulphuric acid; this acid is decomposed by dry distillation, and the xylol thus obtained is further purified. Pure xylol is colourless, it has a faint odour, somewhat like benzol, but different; boiling-point, 139° C.; sp. gr., 866.—*Pharmaceutical Journal.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, January 15, 1872.

This number contains the following original memoirs and papers relating more particularly to chemistry:—

Combustion of Carbon by Oxygen.—J. Dumas.—This very lengthy and exhaustive essay, written more especially to refute the theory of Dr. Dubrunfaut on the combustion of carbon by carbonic acid in the presence of water, is, notwithstanding its high scientific value, not well suited for any useful abstraction, an observation equally applicable to the following memoir:—

Measurement of Very Elevated Temperatures, and on the Temperature of the Sun.—H. Sainte-Claire Deville.

Electrisation by Friction Observed in Sulphide of Carbon, and Decomposition of that Body by the Light.—Th. Sidot.—In the first portion of this paper the author states that when pure sulphide of carbon is placed along with granulated silver or any other granulated metal in a stout glass bottle, and this vessel vigorously shaken, electric sparks are seen inside the bottle; when, while this phenomenon is observed, water is poured on the bottle, the appearance of the sparks ceases immediately, but the phenomenon is observed again when the shaking is continued. By being exposed for several months to strong sunlight in a sealed tube, pure sulphide of carbon appears to become decomposed, giving rise to a solid, flocculent, red-coloured matter and a pecular kind of gas, but the author has not yet been able to test the nature of these products.

Conversion of Phenol into Alkaloids.—L. Dusart and Ch. Bardy.—After first referring to the discoveries of Drs. Laurent, Hofmann, Sterry-Hunt, and others in this department of chemistry, the authors, while minutely describing their method of experimenting, state that the result of heating together in a sealed tube, at from 310° to 320°, a mixture of phenol, sal-ammoniac, and hydrochloric acid, is the formation of chloride of phenyl, some phenylamine, and a large quantity of diphenylamine.

Production of Cymen from the Hydrate of Oil of Turpentine.—Ph. Barbier.—By first treating crystallised terpine—

$$C_{20}H_{20}O_4+H_2O_2,$$

with bromine, there is formed a compound which appears to be a bromated derivative from a bromhydrate of terpilen; this body, on being submitted to distillation, yields a large quantity of bromhydric acid and a hydrocarbon which, on being purified, was found to boil at from 176° to 179°, to have at 15° a sp. gr. of 0·864, and to yield on being analysed results identical with those given by cymen, viz., in 100 parts—Carbon, 89·55; hydrogen, 10·45.

Note Relating to the Reaction which is Produced between Sulphur and Steam, to the Synthesis of Sulphuric Acid, and to the Preparation of Pure Zinc by Electrolysis.—Dr. V. Meyers.—This memoir is divided into the following sections:—Reaction between boiling sulphur and steam; synthesis of hydrosulphuric acid; preparation of pure zinc by electrolysis.

January 22, 1872.

This number contains the following original papers and memoirs more especially relating to chemistry:—

Simultaneous Distillation of Water and Iodide of Butyl.—I. Pierre.—From the description of the author's experiments, illustrated in this paper by a woodcut representing the delineation of the phenomenon of the ebullition of the two fluids alluded to, the following conclusions can be deduced:—When butylic iodide and water are distilled together, the ebullition of this mixture takes place at 96°, that is to say, that the boiling-point is lowered by 26·5°; this degree of ebullition remains unchanged as long as the two liquids are in contact with each other, and appears to be independent of the relative proportions of the two fluids. The proportion of liquid distilling over is 21 of water to 79 of iodide of butyl; this relative proportion is independent of that of the quantities of the two liquids contained in the retort. Ethylic iodide behaves in a similar manner; when in the presence of water, the mixture regularly boils at 66°, while this iodide boils by itself at 70°; the only difference is that the quantity of water distilled over in this instance is only from 3 to 4 per cent.

Report on a Memoir of M. Grüner on the Action of Oxide of Carbon upon Iron and its Oxides.—H. Sainte-Claire Deville.—Notwithstanding the very high intrinsic merits of this lengthy essay, its contents are not suited for useful abstraction, an observation also relating to the following paper:—

Researches on the Induction Currents of an Electro-Magnet between the Poles of which a Metallic Disc is Made to Move.—H. de Jacobi.

Analytical Method of Separation of the Two Isomeric Toluidines from each other.—A. Rosenstiehl.—The author describes at great length a process of volumetrical analysis, which is based upon the different compounds which the two isomeric toluidines form with oxalic acid. The crystalline toluidine forms with oxalic acid only one combination, viz., an acid oxalate—

$$C_2O_4H_2.C_7H_9N\alpha.H_2O\,;$$

this salt is at 15° soluble in 125 parts of water and in 6600 parts of ether free from alcohol. Pseudo-toluidine forms two oxalates, one of these, $C_2O_4H_2.C_7H_9N\beta.H_2O$, is at 18° soluble in 200 parts of ether; the other, a neutral and anhydrous salt, $C_2O_4H_2.(C_7H_9N\beta)_2$, is at 18° soluble in 267 parts of ether. The author first prepares ether free from alcohol (it is not necessary that the ether should be anhydrous); next, a solution of 5 grms. of pure toluidine (which becomes solid at 45°); and, lastly, a solution of oxalic acid, equivalent volume for volume to the preceding solution. By means of a preliminary assay, the purity of the ether is tested, for which purpose 12 c.c. of that ether are taken, and there is added to that bulk of fluid 0·2 c.c. of the two titrated liquids; the result is the formation of 0·0022 grm. of acid oxalate of toluidine, requiring for its solution 16 grms. of ether, and, if this liquid is sufficiently pure (free from alcohol in this case), the oxalate should not be all dissolved, but a portion thereof remain adhering to the sides of the test-glass in the shape of small crystals. The assay of a sample of toluidine is effected by taking first 0·2 grm., and dissolving this in 80 grms. of ether; next, the oxalic acid solution is added by means of a burette; a precipitate of the acid oxalate is formed at once, but, in order to ascertain the end of the operation, it is necessary to filter a portion of the fluid, and to add one drop of the oxalic acid solution, which should yet produce a precipitate of small crystals of the oxalate at the surface of the liquid adhering to the glass. In order again to be sure that no excess of the oxalic acid solution has been added, it is necessary to test with the titrated toluidine solution, while, as regards the precipitate just mentioned, it should be tested for being really a salt of toluidine.

Preparation of Ozone in Concentrated State.—A. Houzeau.—This paper contains the description of a contrivance for the preparation of larger quantities of ozone, the instrument herein alluded to being named an *ozoniseur*; the author is engaged with a series of experiments, the results of which will be communicated at a future date.

Les Mondes, February 1, 1872.

This number opens with the programme of what the excellent editor aptly terms—

Salle du Progrès Soirées et Matinées de Science Illustrée.—Rev. F. Moigno.—We are glad to hear of the efforts made by the *savant* just named for the purpose of procuring to the middle and labouring classes of Paris useful and recreative rest from toil and labour, by providing instruction and recreation for the people, viz., musical entertainments; lectures on various subjects belonging to different sciences, illustrated by experiments, specimens, diagrams, oratorial exercise, and reading; applied sciences, and review of the scientific and industrially remarkable novelties of the day. Provision is made for the daily distribution of gratis tickets, while, further, the price of admission to these halls (seven are now open) is very moderate indeed. We sincerely wish this good work all the success it deserves in the interest of the sound regeneration of France, and more especially the inhabitants of its capital. **"Fluctuat nec mergitur."**

Electrical Turbine.—M. Ruhmkorff.—The description, illustrated by a woodcut, of a very neat and ingeniously contrived apparatus for demonstrating the direction of electric currents.

Economical Industrial Production of Ice and Cold.—Ch. Tellier.—The author describes at length an arrangement and apparatus whereby the vapourisation of ether is employed for the production of intense cold, provision being made to recover the ether in a very ingenious way, by causing it to be absorbed by sulphovinic acid, from which it is afterwards again separated by a simple distillation. An apparatus is now being made according to the author's instructions with which it will be possible to manufacture a ton of solid ice per hour, while the apparatus, of great simplicity and without any complicated fittings, will admit of constant action, and thereby making the ice at a very low price.

Spontaneously Explosive Compound.—Rev. F. Moigno.—When finely pulverised chlorate of potassa is put upon a piece of paper (best dredged or dusted over it, so as to form a thin film of powder), and there is next poured over it a solution of phosphorus in bisulphide of carbon, there ensues, when the latter is evaporated suddenly, a most violent explosion, owing to the phosphorus being left in a state of extremely minute division and in intimate contact with chlorate of potassa. This explosion is analogous to that which ensues when a small piece of phosphorus and some chlorate of potassa are, when placed upon an anvil, struck with a hammer, but, in the instance alluded to, the effect produced is greater, owing to the extreme state of division and intimate mixture of the two substances. Care should be taken not to make this experiment with too large quantities of the chlorate and phosphorus solution, for fear of serious accidents which might ensue.

Bulletin de la Societé d'Encouragement pour l'Industrie Nationale, November, 1871.

This number does not contain any original papers on chemistry, but we abstract from the programme of the Industrial Society of Amiens (Département de la Somme) the following prize questions relating to chemistry:—Analytical experiments of divers kinds of butchers' meat; researches to be made on its varying nutritive quality, and on the relation existing between that property and the composition of the meat; horse-flesh to be included in this investigation; gold medal. To find a compound which, in dyeing wool, may be used instead of bitartrate of potassa for such colours as require this ingredient and tin salt; the compound ought not to contain any tartaric acid or combination thereof; £40 and gold medal. The gold medal for any important improvement in the bleaching of wool or silk. Treatise, theoretical and practical, and investigation of the divers methods applied in industry for the bleaching of hemp; gold medal. Manuscripts of memoirs, samples, &c., are to be sent postage and carriage paid, to the President of the Industrial Society, 48, Place Saint-Denis, at Amiens, on or before June 15 next, but not later.

La Revue des Scientifique de la France et de l'Etranger
January 13, 1872.

Chemical Society of Paris.—We meet here with a brief account of the proceedings of the last meeting of this institution (January 5, 1872), from which account we quote the following particulars:—"Dr. Bourgoin states that he has tried to obtain oxymaleic acid, $C_4H_4O_5$, which should only differ from malic acid by two atoms of hydrogen less; for this purpose he has heated one molecule of bromo-maleate of silver, $C_4HBrO_4Ag_2$, with one molecule of bromo-maleic acid, $C_4H_3BrO_4$; hereby all the bromine is eliminated as bromide of silver, and an acid is obtained which is probably oxymaleic acid, $C_4H_4O_5$, but which has not yet been analysed by the author. By successfully treating the chlorated derivatives of anthracen with nitric and sulphuric acids, Dr. Schützenberger states that he has obtained a red-coloured needle-shaped crystalline compound which resembles alizarine, but differs from it by its insolubility in alkalies and composition, $C_{14}H_8O_2$ (alizarine being $C_{14}H_8O_4$). The new body alluded to is converted by being heated to 300° into yellow-coloured anthraquinon, while by being again treated by hyposulphite of soda in solution the substance is reduced and again becomes red-coloured.

This number also contains the following original paper:—

Physico-Chemical Conditions of Living Beings—Animal Heat.—Dr. C. Bernard.—The reproduction of a lecture given by the celebrated *savant*.

January 20, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to the following memoirs:—

Free Universitary (Higher) Instruction.—Dr. P. Lorain.—This portion of this essay treats on the power of the state over public instruction; universities as purely ecclesiastical institutions; origin of the University of Paris; royal power (viz., as exercised in the olden time as regards universities); claims of the Society of Jesus in reference to public instruction; universities of the future.

The Coal Formation.—Dr. C. Contejean.—A very clear and succintly written paper on everything which bears upon the origin, mode of formation, and fossils of the carboniferous sedimentary rocks.

January 27, 1872.

This number opens with an exhaustive—

Report of the Committee of Inquiry on the Newly Built (as yet Unfinished) Hôtel-Dieu, in Paris.—Dr. P. Lorain.—The unanimous conclusion of the nine gentlemen forming this Committee is that the building alluded to is absolutely constructed against all rules of sound hospital hygiène, and therefore should not be used for the purpose for which it has been constructed.

Lecture on Anthropology.—Dr. Quatrefages.—We call attention to this paper on account of the very interesting facts quoted and proved by the author in reference to the origin and causes and effects of intermingling of the inhabitants (different races) now living in Europe.

This number contains a condensed well-written report of the proceedings of the meeting of the Chemical Society of Paris held on January 19, but, as regards abstracting from this paper, we deem it better to await the publication of the *Bulletin Mensuel* of this society.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 4, 1872.

This number contains the following original papers and essays:—

Note on the Class of Bodies Designated as Alcohols in Chemistry.—Dr. Hamel.—The author gives in this excellent paper a succinct and very clear review of the subject just named, elucidating his dissertation by a tabulated form, exhibiting for monoatomic, diatomic, triatomic, tetratomic, and hexatomic alcohols, the formulæ of these different bodies, and also explaining the real meaning and origin of the word alcohol.

Automatic Acting Plug for Preventing Foul Water and Noxious Gases from Escaping from Sinks, Sewers, &c.—MM. Nillus and Roussel.—Illustrated by woodcuts. This contrivance has met with great success in Paris, and is arranged to withstand considerable pressure.

Continuation of Essay on Fermentation.—C. Mène.—An excellent historico-critical review is here given on this much discussed subject.

January 11, 1872.

This number does not contain any original matter relating to chemistry.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xvi., No. 6, 1871.

This number does not contain any original papers relating to chemistry.

Journal de Pharmacie et de Chimie, January, 1872.

The papers and memoirs on scientific chemistry contained in this number have already been published in the *Comptes Rendus*; among the pharmaceutical papers we notice—

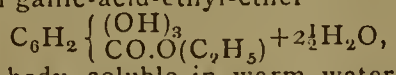
Some of the Tests for Detecting Strychnia.—Dr. Filhol.—After having reviewed the various tests described in works of chemistry, the author concludes that as regards the sure detection of this alkaloid in cases of poisoning it should be obtained in a solid state; the alkalinity of its solution should be ascertained as well as its intensely bitter taste; its behaviour with chlorine, and its blue colouration under the influence of sulphuric acid and oxidising substances, should also be seen; while, lastly, as a very delicate reaction, the author quotes that, with chloride of gold, strychnia (in solution) yields immediately a crystalline precipitate, which, although slowly, is yet formed in solutions containing 1-10th of a milligrm. of the alkaloid. This precipitate, and that formed by chlorine, are at once dissolved by concentrated sulphuric acid, and, chromic acid being added, the well-known blue colouration that strychnia yields with this last reagent is produced. The presence of alcohol in liquids to be tested for strychnia should be avoided.

This number contains an excellent biography and review of the scientific labours of the late *savant*, G. Guibourt.

Pharmaceutische Zeitschrift für Russland, No. 17, 1871.

This number contains the following original paper:—

Gallic-Acid Ethers.—F. Ernst and C. Zwenger.—This lengthy and exhaustive essay treats on the mode of preparation and properties and combinations of gallic-acid-ethyl-ether—



$$C_6H_2\left\{\begin{matrix}(OH)_3\\CO.O(C_2H_5)\end{matrix}\right.+2\tfrac{1}{2}H_2O,$$

a solid crystalline body, soluble in warm water, and readily so in alcohol and ether; when rapidly heated, the crystals fuse at 90° in their water of crystallisation; at a higher temperature, this ether is partly volatile without decomposition. Gallic-acid-methyl-ether and gallic-acid-amyl-ether are also described at length; in some respects these ethers resemble gallic acid in their behaviour with reagents.

No. 18, 1871.

The only original paper contained in this number is—

Essay on the Condition of the Water of Infiltration of the City of St. Petersburg.—Dr. J. Erichsen.—The first instalment of a monograph on this subject, which is, however, chiefly of local interest.

No. 19, 1871.

This number contains the following papers:—

Continuation and End of the Essay on the Condition of the Water of Infiltration of the City of St. Petersburg.—Dr. J. Erichsen.

Contribution to the History of the so-called Theory of Types (Typenlehre).—Dr. Wittstein.

No. 20, 1871.

This number does not contain any original papers.

No. 21, 1871.

This number contains the first instalment of an essay—

Fruit of the Vanilla Planifolia and its Constituents.—Dr. W. von Lentner.—This portion is devoted to historical notices concerning this fruit and its pharmacognostical characteristics. It appears that vanilla was first known in Europe about the year 1593; Francisco Hernandez is the first author who, while resident in Mexico, the native country of vanilla, mentions this substance, under the barbaric name of *Tlilxochitl*; the present name of vanilla is derived from the Spanish *bayna* pod, botanically *siliqua*, diminutive of bayna is baynilla. This portion of the author's essay also contains a very complete and valuable record of the cultivation of this orchidaceous plant and its dispersion throughout the hothouses of European botanical and other gardens.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, November, 1871.

This number does not contain any original papers relating to chemistry.

NOTES AND QUERIES.

Asbestos Cloth—Loss of Mercury.—(Reply to C. T. Kingzett).—Asbestos cloth is still made to some extent at St. Petersburg, and it is very likely that Captain Shaw, the Chief Superintendent of the Metropolitan Fire-Brigade, will be able to inform you where it may be bought in London. As to the fact that sodic chloride acts upon and dissolves mercury, there can be no doubt of it; silver is likewise attacked by common salt, and for that reason silver or electro-plated salt-cellars and salt-spoons are gilt inside, pure gold not being acted upon by common salt, nor is platinum, which is occasionally used, at least abroad, to make salt-spoons.

MEETINGS FOR THE WEEK.

Monday, Feb. 19th.—Medical, 8.
—— Anthropological, 8.
—— London Institution, 4. Prof. Odling, F.R.S., "On Elementary Chemistry."
Tuesday, 20th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Zoological, 9.
Wednesday, 21st.—Society of Arts, 8.
—— Meteorological, 7.
—— Geological, 8.
Thursday, 22nd.—Royal, 8.30.
—— Royal Society Club, 6.
—— London Institution, 7.30.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
Friday, 23rd.—Royal Institution, 9. Mr. H. Leslie, on "Social Influence of Music."
—— Quekett Microscopical Club, 8.
Saturday, 24th.—Royal Institution, 3. Mr. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

TO CORRESPONDENTS.

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J. B. G.—A book on the subject is in the press; it will be duly announced in our columns.

G. C.—By the addition of alcohol 1 part of sulphate of lime is soluble in about 400 parts of water, but it is insoluble in dilute spirits.

A. D.—Yeates, 39, King's Square, Goswell Road.

J. H. St. P.—The following are useful works on the refining of petroleum:—"Handbuch der Photogen und Paraffin Fabrikation aus Torf, Braunkohle, und Bitiminösene Schiefer," von E. Uhlenhuth; Quedlinburg, 1858. "Die Industrie der Mineralöle des Petroleums, Paraffins, und der Harze," von H. Perutz; Wien, 1868. "Coal, Petroleum, and other Distilled Oils," by A. Gesner; London: Baillière. "The Manufacture of Photogenic or Hydrocarbon Oils from Coal and other Bituminous Substances, &c.," by Dr. T. Antisell; New York: Appleton. Mr. Bancroft refines oils for machinery and lubricating purposes generally by agitating them with a lye of caustic soda 1·2 sp. gr.; a sufficient quantity has been added if, after standing, a portion begins to settle down clear at the bottom. About 4 to 8 per cent of the soda solution is commonly required for lard and olive oil; after standing for twenty-four hours, the clear supernatant oil is decanted from the soapy sediment and filtered.

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THE CHEMICAL NEWS.

Vol. XXV. No. 639.

NOTE ON THE SOLUBILITY OF GOLD,
AND THE
STABILITY OF AURIC NITRATE AND SULPHATE.

By ALFRED H. ALLEN, F.C.S.

Reynolds, in the Chemical News of 1864 (vol. x., p. 48), called attention to the solubility of gold in a mixture of strong nitric and sulphuric acids, with production of a yellow liquid, which turned purple on addition of water and gave a precipitate of metallic gold, no metal remaining in solution.

I have tried the effect of solid permanganate of potassium and concentrated sulphuric acid on gold. The precipitated metal was heated with the oxidising agent for a few minutes till the solution became nearly clear, and the evolution of gas had ceased. The mixture was allowed to cool, and was then poured into water, which turned pink, owing to the presence of a small quantity of undecomposed permanganate or manganic sulphate. On testing with oxalic acid or ferrous sulphate, the solution was found to contain abundance of gold. The permanganate used was pure and free from any trace of chloride, so that the gold in this solution must have existed as sulphate.

On making a similar experiment in which nitric acid was substituted for the sulphuric acid, only a minute trace of gold could be detected in the solution.

Platinum was not dissolved when heated with permanganate and sulphuric or nitric acid. This is rather remarkable, as platinum forms well-defined and tolerably stable sulphates, and, when alloyed with silver, is readily dissolved by nitric acid.

I prepared some pure auric oxide by precipitating a solution of gold in aqua regia with considerable excess of magnesia, boiling, washing with hot water till the washings were perfectly free from chloride, dissolving the precipitate in dilute nitric acid, boiling and washing till the water no longer reddened litmus.

The auric oxide so obtained was heated with strong nitric acid, in which it is well-known to be soluble, all authorities stating that dilution causes the complete precipitation of the gold as auric oxide. This I do not find to be the case, a perfectly clear and nearly colourless solution being obtained on dilution, in which the gold must evidently be present as nitrate, as argentic nitrate gives no trace of precipitate, and no other salt radical is present. The solution of auric nitrate answers to the ordinary tests for gold, and is but gradually decomposed, with deposition of auric oxide having the same properties as before. The decomposition is more rapid when the liquid is heated.

On pouring concentrated sulphuric acid over auric oxide a muddy liquid is produced which becomes clear and yellowish on application of gentle heat. Instead of being completely decomposed by dilution, as stated by Gmelin, it either remains perfectly clear or merely gives a purplish precipitate of finely-divided gold. The solution contains auric sulphate and gives the usual reactions of gold with stannous chloride, ferrous sulphate, and oxalic acid, so that the gold is evidently in a state of true solution.

The "sulphate of auric oxide," described in Gmelin's "Chemistry," and prepared in the above way, is said to be completely decomposed on dilution, with precipitation of the whole of the gold as auric oxide. I have not found this to be the case, solutions of auric sulphate depositing but very gradually a portion of the gold as a dark precipitate soluble in hydrochloric acid, but the decomposition never seems to be complete, and, in some instances, is very slight.

I am inclined to differ from Reynolds and Spiller,[*] who concluded that the solution of gold obtained by heating the metal with sulphuric and nitric acids did not contain auric sulphate. The real cause of the purple colouration produced by dilution of the acid liquid is, undoubtedly, the reduction of the metal by a lower oxide of nitrogen (probably nitrous acid), produced by the action of the gold and heat on the nitric acid employed. This is proved by the fact that when the water used for dilution is coloured pink by permanganate, little or no precipitation occurs, the nitrous acid being oxidised by the permanganate before the former can effect the reduction of the gold.

This may be further demonstrated by adding a small fragment of ammonium sulphate to the concentrated acid liquid, and again boiling, when the nitrous acid is destroyed, no purple colouration is produced by dilution, and the solution is not distinguishable from the auric sulphate obtained by solution of auric oxide in acid, or by boiling gold with sulphuric acid and permanganate. On adding to any of the liquids a few drops of fuming nitric acid, the gold is thrown down as a purple precipitate, which shows that nitrous acid is competent to produce the effect. This reaction also occurs when fuming nitric acid is added to a solution containing auric nitrate.

Solutions of auric sulphate containing also sulphate of sodium, ammonium, or manganese, appear to possess greater stability than those of the pure salt, but I have not succeeded in obtaining any definite double sulphate.

The above experiments show that gold is more readily oxidised in the wet way than is generally supposed, and that the nitrate and sulphate possess far greater stability than they have received credit for.

Sheffield, Feb. 16, 1872.

NOTE ON THE DOCIMASTIC ASSAYING OF BISMUTH ORES,
AND ON THE
DOCIMASTIC SEPARATION OF BISMUTH FROM COPPER, FROM ARSENIC, FROM ANTIMONY, AND FROM LEAD.

By HUGO TAMM.

Chemically, and one might almost add commercially, bismuth is one of the precious metals. It is the least precious of all, but its metallurgy, like that of its congener, is of the simplest description, amounting as it has done for a long while, to the mere process of running the metal out of its matrix, since as is the case with precious metals, native bismuth has been the chief source of the commercial product. But this ever limited source is becoming well nigh exhausted, whilst the demand for this metal, and especially for the metal in a great state of purity, is increasing every day. It has thus become an imperious necessity to look for fresh fields of exploration, for new deposits, and as bismuth ores of every description mixed up with other ores of various kinds are now used for the extraction of bismuth, the metallurgy of this metal has somewhat lost of its former simplicity, and in order to overcome the difficulties introduced with the new ores, new reactions or fresh applications of known reaction have been found indispensable.

I have, I think, done more than any other metallurgist towards bringing to perfection both the extracting and the refining of bismuth, especially in a docimastic point of view, for, until then, those two chief parts of the metallurgy of bismuth were almost as much of the nature of mechanical operations as of chemical reactions.

I shall divide my subject into two parts—

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[*] Chemical News, vol. x., pp. 167, 173, 277.

1. The extracting or assaying of bismuth. 2. The refining of crude bismuth.

1. *Extracting or Assaying of Bismuth.*

Whenever the ore to be tried or run down is of a simple nature, is free from admixture with other ores, and contains bismuth in the metallic state, or in the state of sulphuret, of oxide, or of carbonate, or, as sometimes occurs, consists of a mixture of oxide, carbonate, subsulphate, and oxychloride, the extracting or assaying of bismuth is reduced to the very simple operation of mixing the ore with as fusible a flux as can easily be obtained, to which a reducing substance, generally charcoal powder, is added in proper quantity.

It is of course useless to lay down particular rules concerning the nature or the quantity of the flux, and of the reducing substance to be employed in this operation; indeed, it is not advisable to do so, and it is by far the best to be guided by the nature of the materials at hand, and by the results of a few trials with varied proportions of flux and of the reducing agent; the aim of the assayer or of the metallurgist being the highest amount of metal that can be obtained in a given instance. Still, one of the best fluxes, as well as one of the most simple, consists of a mixture of two parts of carbonate of potash or soda, and one part of chloride of sodium, to which a proper amount of red argol or of cyanide of potassium on the small scale, and powdered charcoal on the large scale, are added. There is absolutely nothing new or important connected with this operation, and there is no reason to presume that it will ever be deeply modified.

2. *Extracting or Assaying of Bismuth in Ores containing a large amount of Copper.*

The problem of the direct separation of bismuth from ores containing large proportions of copper was one of great difficulty, and its solution, which was of great importance, offered great interest. The difficulty consisted chiefly in the fact that both copper and bismuth behave, in nearly every instance, in an identical manner with docimastic reagents; but I have very happily hit upon a most simple and practical means of effecting the direct separation of those two metals.

The chief kinds of ores containing both bismuth and copper are the bismuth copper pyrites or sulphuretted ores, and the double oxides or carbonates of bismuth and copper, or oxidated ores.

Both kinds of ores may be, and generally are, contaminated with other metals, but these foreign metals constitute only, as a rule, a small fraction of the whole, and the problem of their elimination will be found under the head of Refining.

The reaction upon which the separation of bismuth from copper is founded consists in the fact that, in presence of alkaline fluxes, carbonaceous reagents, and, of course, among them carbon itself, reduce sulphuret of bismuth to the metallic state, while sulphuret of copper is not reduced.

In the treatment of sulphuretted ores, both metals being already in the state of sulphurets, all that is required is to run them down with a mixture of carbonate of potash or soda and salt, to which a little flowers of sulphur or ground sulphur and charcoal or any other carbonaceous substance is added.

In this operation metallic bismuth is extracted quite easily, and the metal thus obtained is tolerably free from copper. It is recommended to add a little sulphur in order to ensure a complete sulphurisation of copper during the whole of the operation, and especially to prevent any desulphurisation of copper by the alkali, and, consequently, to prevent, as much as possible, this metal from being reduced.

With oxidated ores the operation is very similar in every respect to the one just described, and it differs from it only by the amount of sulphur used, which is greater in this instance since the whole of the metals have to be sulphurised.

Three parts of the ore are mixed with from two to three parts of a flux composed of:—

Carbonate of soda	5 parts
Salt	2 ,,
Sulphur	2 ,,
Charcoal powder	1 ,,

Both the composition of the flux and the amount to be used may be altered with advantage to suit each particular case. A few synthetical trials, in the hands of a person accustomed to docimastic or metallurgical operations, are all that are required to make the best use of this reaction.

In general, it is to be observed, that the amount of flux and of reagents required for the assaying may be considerably *reduced* when the operation is carried on on a larger scale. On the other hand, it is scarcely worth while mentioning that, in the operation of assaying, cyanide of potassium forms an admirable substitute for carbon.

During the process of extracting bismuth by means of sulphur and carbon there is a loss of about 8 per cent of the bismuth contained in the ore. This loss is unavoidable, but there is a more than proportionate loss of the metals arsenic, antimony, and lead, which, in this operation, are reduced with bismuth, and the crude metal obtained by this process is not so impure as the corresponding metal obtained by the direct reduction of the oxidated ores; besides, the whole of the copper remains in the slag.

Whenever the sulphur-carbon process is employed, the use of iron stirrers must be carefully avoided, for the reason that sulphuret of copper is rapidly reduced to the metallic state by this metal, especially in presence of alkalies.

The problem of the docimastic separation of bismuth from copper, certainly one of the most difficult that metallurgy could offer, has thus been solved in the most simple manner.

The introduction of sulphur as a direct docimastic reagent in metallurgical operations will be, I trust, a new era in that branch of industry. The facility with which a difficult problem has been solved by its use may lead to the most sanguine expectations, and to give an idea of its probable future importance, I will quote an instance little known, and which, although not bearing directly on the present subject, is derived from it.

When an alloy of lead and antimony is sulphurised by the direct action of sulphur at a red heat, contrary to all anticipation, lead is gradually sulphurised first, and, after a while, a layer of metallic antimony, tolerably free from lead, is found under a layer of sulphuret of lead tolerably free from sulphuret of antimony. This fact is really very remarkable, the more so that lead and antimony, which may differ essentially in a docimastic point of view, when separated, behave in a nearly identical manner when once alloyed.

The process which I propose for the separation of bismuth from copper will be found chiefly useful and important for the separation of bismuth in minerals containing large quantities of copper. When, on the contrary, this metal exists only in smaller proportions, it is more advantageous to run down the whole of the metals, and to separate them afterwards in the special operations of refining. But I should recommend the sulphur-carbon process for the treatment of the somewhat abundant ores of bismuth formed of oxides of bismuth and lead, and small proportions of arsenious acid and antimonious acid, with a little oxide of copper; for there is as yet no direct means of smelting pure bismuth from ores containing large proportions of lead, but it has been observed that bismuth extracted by the sulphur process contains less lead than the corresponding metal obtained direct from the oxidated ore. The same remark applies to arsenic and antimony, and this is in accordance with the behaviour of the sulphurets of these metals with alkaline sulphurets.

Docimastic Refining of Crude Bismuth.

The various ores of bismuth which I have described, whether sulphuretted or oxidated, are seldom formed of bismuth and iron only, or of only bismuth, copper, and iron. They nearly always are contaminated by various proportions of lead, of arsenic, of antimony, metals which are reduced with bismuth, partially, at least, whatever process has been used for the extraction of bismuth, and, besides, the metal obtained by the sulphur process from copper-bismuth ores still contains a small quantity of copper, which it is important to remove.

Bismuth extracted by any process is so generally free from iron that no notice need be taken of this metal, which remains wholly in the slags.

The fracture of good bismuth and that of its various alloys is so characteristic that it is not often necessary to have recourse to tests in order to determine what particular processes will have to be used for the refining of the crude metal.

Pure bismuth is tougher than most of its alloys. Its fracture is bright, and it possesses a fine reddish colour. Bismuth containing arsenic gives a beautiful fracture, consisting of large laminæ of a whiter colour than that of pure bismuth. Copper mixes with bismuth without alloying with it, and is almost always discernible. The fracture of bismuth containing antimony is dull and is mostly composed of very small crystals. Lead does not prevent bismuth from crystallising in large crystals, but these crystals are studded all over with fine crystals. Sulphur imparts a black tinge to metallic bismuth.

To these appearances, which almost suffice to an experienced eye, may be added a few simple tests.

It is difficult to detect arsenic in presence of a large quantity of bismuth by means of reagents, and the most simple way of detecting this substance is to heat the bismuth on charcoal, with the oxidising flame of the blowpipe. Very small quantities of arsenic may be detected in this way.

To detect copper, the metal is dissolved in nitric acid, the solution is supersaturated by ammonia, and filtered. The blue colour of the filtrate indicates the presence of copper.

When bismuth dissolves in strong nitric acid, with formation of a cloudy white precipitate which does not disappear on addition of water, it is because antimony is present.

When bismuth dissolves in strong nitric acid, with formation of a very white granular or crystalline precipitate which dissolves freely on addition of water, this indicates the presence of lead.

But to detect with absolute certainty the presence of even very small proportions of lead, the metal is dissolved in nitric acid. The solution is supersaturated by ammonia, and re-acidulated with the smallest amount of hydrochloric acid which will give a clear liquor. This liquor is then precipitated by a large excess of boiling water. Water must be added until no further precipitation takes place. The whole is then filtered, and the filtrate is saturated by a mixture of ammonia and carbonate of ammonia; when a yellowish-white precipitate is formed it is because lead exists in the bismuth.

It may be useful to submit the metal to be refined to these various tests in order to ascertain beforehand which refining process should be used. But it is essential to apply each test to the refined metal, so as to verify its degree of purity.

(To be continued).

ANOMALOUS PRODUCTION OF OZONE.

By HENRY H. CROFT,

Professor of Chemistry, University College, Toronto.

About six years ago, when evaporating some syrupy iodic acid, prepared according to Millon's process, over sulphuric acid, I noticed that when the acid began to crystallise, the air in the jar (covering the drying dish) had a strong smell of ozone, or active oxygen. A couple of years afterwards, on again making iodic acid, this observation recurred to my mind, and I carefully tested the air in the jar during the evaporation; no trace of ozone could be detected until the acid began to crystallise, when the smell of ozone became immediately perceptible, and all the usual tests for that body succeeded perfectly.

During the last month I have had occasion to convert 2 ozs. of iodine into iodic acid, and exactly the same result has been observed. The acid usually solidifies to opaque verrucose masses; but on this occasion the crystals formed were clear and brilliant. The solution had in this, as in all the former cases, been boiled down to thin syrup, so that no trace of chlorine or nitric acid could possibly have remained to act on the ozone paper. The air in the jar was tested from day to day, both by the smell and the action of iodised starch paper. Even when a few crystals began to form no change was noticed, but when the crystallisation set in fully the evolution of ozone was most remarkable, the strong smell being quite characteristic, entirely different from that of chlorine or nitric acid.

I am quite unable to account for this ozonification of the air (or oxygen) over crystallising iodic acid. My friend Mr. Sterry Hunt has suggested that it may arise from a partial deoxidation similar to that which produces ozone when hypermanganates are decomposed, as observed by him and other chemists. As the crystallising acid remains perfectly white, either opaque or transparent, and as the lower oxides of iodine are of a yellow, or even brown colour, according to Millon, I cannot accept this explanation, and even if it were true, the phenomenon would be equally unintelligible—a reduction taking place during crystallisation. I can offer no explanation of the simple fact that air over crystallising pure iodic acid becomes ozonised, but I think that the observation seems to offer a wide field for further experiments, which I have, unfortunately, not the time to carry out.

ON THE DIFFUSION OF MERCURIAL VAPOURS.

By M. MERGET.

From the facts given in a former portion of this paper, quoted in abstract in our "Chemical Notices" a few weeks ago, a great number of applications may be deduced, of which some of the most important are the following:—

I observe, in the first place, that, as regards analytical chemistry, the ammoniacal nitrate of silver test-paper becomes a very sensitive and precise reagent for the detection of mercury. We are all acquainted with the test whereby a piece of bright metallic copper or gold, by electro-chemical action, is employed for the detection of mercury, which, by forming a white-coloured amalgam with the copper and gold, and by the volatilisation of the mercury by the application of heat, is readily recognised; but if the liquor thus tested for mercury does not contain a rather large quantity of mercury, this test is not sufficiently decisive. In such a case, when they cannot distinguish the formation of an amalgam, it is only necessary to bring the piece of gold or copper into contact with ammoniacal nitrate of silver paper for the purpose of obtaining a brown colouration, which characteristically indicates the presence of mercury. By operating in this manner, I have been able to demonstrate the presence of mercury in a solution containing 1-100,000th part of bichloride. When mercury is set free and volatilised in the dry way, it is usually seen in the shape of very small globules, only visible by the aid of a magnifying glass; but when the quantity of mercury is very small, these globules may happen to be altogether invisible. The smallest trace of vapours of mercury, absolutely too small to cause any perceptibly visible deposit of globules, is immediately rendered apparent by their action upon the test-paper just alluded to. Reciprocally, vapours of mercury may be usefully applied for the detection of the salts of the noble metals, by the deep colours the solutions of these salts imparted to paper assume by being exposed to the vapours of mercury. The solutions of the salts of platinum and iridium may be used to write with a pen or paint with a camel's-hair brush on paper, or on other substances which do not chemically alter and affect the composition of these salts; and what is so produced on paper will, after having been exposed to the mercurial vapours, be almost indestructible by all chemical reagents. The combined application, therefore, of these salts, and of the vapours of mercury, yield scope for the making of indelible inks suited for writing or making drawings on paper, linen, wood, &c. Made up with salts of gold, palladium, and silver, these inks, though less unalterable, may be, however, advantageously employed in many instances in the same manner. Instead of using the solutions of these salts as writing ink, the solutions may be painted in thin films over ordinary paper, and this next exposed to the vapours of mercury evolved from previously mercurised figures or drawings. I have thus succeeded in solving the problem of photographic printing without light. For this purpose, I first prepare a positive (on glass or paper) so that it is thoroughly impregnated with mercurial vapours, condensed and absorbed by finely-divided reduced silver, these vapours being evolved when the positive is pressed against a piece of paper sensitivised with the solution of a salt of any of the precious metals. The proofs thus printed, supposing a silver salt to have been used, are fixed by the processes in use in photography; when salts of gold, palladium, platinum, or iridium have been used, the fixing of the print is obtained by simply washing with water—leaving the prints for ever absolutely unalterable by light and all atmospheric action, while, moreover, the prints produced by reduced platinum or iridium are indelible and cannot be destroyed without the aid of chemical agents, which would also destroy, or at least entirely alter, the paper on which the prints are made. It is clear that steel and copper and photo-chemical engravings may be treated in a similar way.

The permeability of mercurial vapours through porous substances has enabled me to take upon sensitised paper the impressions of leaves and twigs of plants, which are thus reproduced with great neatness and correctly resemble the original. As regards the detection of mercurial vapours and the presence of mercury in toxicological researches, my discovery of the tests alluded to is of great value. As an instance of the value of these tests, I may here quote that, on visiting a looking-glass factory very well constructed as regards ventilation in every respect, I found the air of this very large establishment saturated from top to bottom with mercurial vapours.

In the discussion which followed the reading of this paper, Professor Boussingault observed that sulphur evolves, in the presence of mercurial vapours, also vapours which neutralise very completely the deleterious effect of the vapours of mercury on the human system.

ON SUPERSATURATED SOLUTIONS OF SODIC CHLORIDE.

L. C. de COPPET, Ph.D.

It was noticed by Blagden, as early as 1788, that solutions of sodic chloride, when cooled below 0° C., are liable to become supersaturated. More recently, Schroeder* prepared supersaturated solution of this salt by cooling to −10° C., in closed vessels, strong solutions prepared by heating. These were previously filtered and heated to boiling in order to remove or dissolve any particles of solid salt which might remain in suspension in the liquid, and prevent, as Schroeder believed, the supersaturation.

I have seen a solution of sodic chloride become supersaturated under the following circumstances:—A solution, saturated by heating, was cooled by means of a strong freezing mixture in an open vessel freely exposed to the nuclear action of the dust floating in the atmosphere; a large excess of ordinary anhydrous sodic chloride was added to the solution, which was continuously stirred with a thermometer. Salt deposited from the solution during the early part of the cooling, but I do not know whether this deposition continued after the temperature had sunk below 0° C. The temperature was still several degrees above the freezing-point of the normally saturated solution (about −21·5° C.) when the liquid suddenly crystallised, forming, together with the excess of salt previously alluded to, a solid mass of such compactness that the thermometer could only be withdrawn with difficulty. This freshly formed crystalline mass consisted very probably of the hydrate, $NaCl,2H_2O$.

It is known that, at ordinary temperatures, the monoclinic crystals of $NaCl,2H_2O$ soon fall to pieces, being converted into minute cubes of the ordinary anhydrous salt and water; this decomposition takes place immediately if the crystals of the hydrate are brought in contact with the smallest particle of ordinary sodic chloride.

It would appear, however, from the experiment just described, that at temperatures inferior to 0° C., the hydrate, $NaCl,2H_2O$, is not decomposed by contact with the ordinary anhydrous salt. In any case, the experiment shows that the presence of the ordinary salt does not prevent supersaturation, and that it is not indispensable either to filter or to cool the solution in a closed vessel.

In order to compare the strength of the supersaturated solution with that of the mother-liquor after crystallisation, I cooled a solution of sodic chloride, saturated near 100° C., in a flask loosely stopped with cotton-wool. The flask was first placed in cold water, then in a freezing mixture at −14° C. During the first part of the cooling process, cubic crystals, due no doubt to evaporation, formed at the surface of the liquid, but sank to the bottom of the flask when this was shaken. A thermometer, immersed in the solution, had been marking −140° C. for some minutes, when a portion of the perfectly clear menstruum was poured into a previously weighed flask provided with a cork, and used to determine the strength of the supersaturated solution. A few minutes later a quantity of transparent crystals formed suddenly, as well as I could judge, in all parts of the liquid simultaneously, and the thermometer rose rapidly from −14° to −11·5° C., and then fell slowly back to −14°. A little later still, the solution in the weighed flask also crystallised, though its temperature must, in the meantime, have risen considerably. A sufficient time having elapsed for the newly-formed crystals to subside, a second perfectly clear portion of the menstruum was poured into another vessel of ascertained weight; then the flask was placed in melting ice and shaken from time time. After the thermometer in the solution had stood for two hours at 0° C., a third portion of the liquid was poured off and the strength of the solution in the three weighed flasks estimated. The determinations showed that the solution contained, in 100 parts of water, of anhydrous sodic chloride,

36·4 parts at −14° C. before the sudden crystallisation
32·5 ,, −14° C. after ,, ,,
35·7 ,, 0° C. ,, ,, ,,

According to Poggiale, a saturated solution of sodic chloride contains 32·7 parts of NaCl at −15° C., and 35·5 parts at 0°. The number given by Mulder* for the solubility at 0° C. is 35·7, the same as I found. It will be seen that all these numbers express the solubility of the

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* *Annalen der Chemie und Pharmacie*, t. 109, p. 46.

* "Scheikundige Verhandelingen, deerde deel, derde stuk, p. 37. Rotterdam. 1864.

hydrated sodic chloride, and not that of the anhydrous salt. A solution containing 36·4 parts of NaCl in 100 water is normally saturated with the anhydrous salt at about +35° C.

The facility with which solutions of sodic chloride are liable to become "supersaturated" explains how certain investigators were led to believe that the solubility of this salt was the same at all temperatures, and how others again believed it to be greater at 0° C. than at ordinary temperatures.

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

XI.

MILK is secreted by the mammary gland and serves for the nourishment of the young animal; the presence of this gland distinguishes the class Mammalia.

This secretion necessarily contains all material for the building up of the body; these are definitely—casein, the albuminous principle; butter, the fatty body; lactose, the sugar; and certain salts. The milk secreted immediately after parturition is named colostrum; it contains albumen in large quantities, which coagulates on boiling, it acts by purging the child: after this has passed away the true milk is secreted; this in most animals, as the cow, horse, &c., is white, but in the human female is much clearer. When viewed by the microscope, it appears as a clear fluid containing innumerable corpuscles in suspension; these are fat enclosed in a casein capsule.

The sp. gr. of milk it is needless to quote, for though great stress has been laid on it as a test for the percentage of water, yet it is of no avail, a milk rich in butter would give a bad result with the lactometer test, whilst skimmed milk, from the absence of butter, would give a good result, though really not so good.

Fresh milk is alkaline and contains the following percentage composition (L'Heretier).

Water..		867·8
Solids—		
Butter	42·5	
Casein	11·7	
Sugar	74·0	
Salts	4·0	
		132·2
		1000·0

Any considerable deviation from these numbers in human milk may be rejected.

So frequently do changes occur in this fluid from some abnormal condition of the mother that, in many cases of disease in children, the cause may be traced to the mother's milk; apart from direct disease foreign bodies may be secreted with it, as iodine, strychnine, &c., the quantity being such as to have no effect on the mother, but yet proving fatal to the child. In infantile disease the physician should make it an invariable rule, when no other cause is to be found, to examine clinically the milk of which the child partakes, when, in a majority of cases, he will find his trouble repaid and his diagnosis assisted.

The process I adopt is as follows:—

Take a measured quantity of milk, and evaporate to dryness on a water-bath, break the dried mass into fragments, and boil with a small quantity of benzol; this extracts the butter, which can be weighed after the benzol has been allowed to evaporate. The dried mass, now freed from butter, may be boiled in alcohol, which removes the casein; this can be weighed also when freed from alcohol. The residue now left may be incinerated for salts, and tested in the ordinary way for phosphates; the sugar may be estimated by the copper test on a fresh portion of milk.

Cows' milk contains more casein and less sugar than human milk; therefore, when used as food for children, it should be diluted with a third water, and a few grains of lactose added for every ounce of milk.

The adulterations of milk are few, water being the chief addition; the casein should amount to 3 per cent in ordinary cows' milk.

An excellent form of pure milk is the Anglo-Swiss condensed milk: pure milk is evaporated to the consistency of treacle, and sugar added; this addition keeps the preparation admirably, a sample exposed for three months under my observation had not appreciably changed at the end of that time.

A DELICATE TEST FOR NITRIC ACID IN WATER.*

By EDWARD NICHOLSON,
Assistant Surgeon R. A., Analyst of Waters Mysore, Ceded, and Northern Districts.

THE sulphate of iron test for nitric acid is uncertain when the quantity is less than 1 in 100,000, and requires considerable care in order to ensure uniformity of results. I have, therefore, tried the degree of delicacy of the brucine test.

This, as recommended by Kersting (*Ann. der Chem. u. Pharm.*, 1863), is used in much the same way as the sulphate of iron test. To 1 c.c. of the water in a small test-tube, add 1 c.c. of an aqueous solution of brucine containing one part in a thousand (which is about the extent of solubility of the alkaloid); then, by a thin pipette, send a few drops of pure sulphuric acid down to the bottom of the tube. If nitric acid is present, a pink zone will appear at the junction of the two liquids, turning yellow before it disappears.

Dr. Parkes, in his "Manual of Hygiene," says that water containing 1-1000th of nitric acid shows this reaction very decidedly; but I find that this is not the limit of sensitiveness, as water containing 1-10,000th, that is, 0 100 grm. of HNO_3 per litre, shows the reaction distinctly; it comes on in about a minute, and lasts for half an hour. Weaker solutions fail to show the reaction; 1-20,000th does not show it.

I have, however, found a much more delicate way of applying the test.

The solution of nitrate of potash used in the above experiment, containing 0·100 grm. of nitric acid per litre, was diluted with 10, 100, and 1000, and 10,000 parts of a water of ordinary composition, containing 0·200 per litre of carbonate of lime and chloride of sodium, and free from nitric or nitrous acids. Each dilution was tested by evaporation of 1 c.c. to dryness in a porcelain dish; the residue was moistened with two small drops of pure and strong sulphuric acid, and a minute fragment of brucine, about the size of a pin's head, dropped in and moved about with a fine glass point.

The original solution gave a blood-red colour, fading to orange.

The first dilution, containing 0·010 of nitric acid per litre, gave a deep pink colour over the whole surface.

The second dilution, containing 0·001 (one part in a million) gave the reaction very decidedly, a fine rose colour following the brucine as it was moved about.

The third dilution, containing 1-10th milligramme per litre, gave a distinct rose colour round the brucine.

The fourth dilution, containing 1-100th milligramme per litre, gave a rose colour to the fragment of brucine. Beyond this point it was difficult to find reagents not giving a faint trace of colour to the brucine.

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* From the *Madras Monthly Journal of Medical Science* for May, 1871.

We have thus the means of detecting readily 1-10th milligramme of nitric acid in a litre of water without any concentration. I hope before long to be able to give a process for the quantitative estimation of nitric acid when it exceeds 1 milligramme per litre.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 15th, 1872.

Dr. Frankland, F.R.S., President, in the Chair.

After the minutes of the last meeting had been read and the donations to the Society announced, Dr. J. Watts and Messrs. C. W. Siemens and J. L Vanderstraaten were formally admitted as Fellows.

The following names were read for the first time:—Messrs. George Attwood, Edward Northway Butt, and William Moss Bowron.

For the third time—Messrs. Lüdwig Mond, Edward Kinch, Edward Packard, jun., John Ruffle, Frederick John Barrett, Edward Handfield Morton, and Ross Scott, M.A., who were then balloted for and duly elected.

Professor Roscoe, F.R.S., "*On the Study of Some Tungsten Compounds.*" The speaker first gave a *resumé* of the labours of other chemists on those compounds of tungsten which had reference to the determination of its combining number, especially criticising the observations of Persoz, who considered the metal to be, like arsenic, a pentad element, and had, in consequence, assigned to it the atomic weight 153, being five-sixths of that usually given, namely, 184. He had prepared and examined a number of tungsten compounds which appeared to establish definitely that this element had the atomic weight 184. Four chlorides had been obtained, WCl_6, WCl_5, WCl_4, and WCl_2, of which the first three corresponded to the oxides WO_3, W_2O_5, and WO_2. The hexachloride, a solid crystalline substance, was formed by passing chlorine over heated metallic tungsten prepared from pure tungstic acid, taking great care to exclude moisture and oxygen, which would give rise to the formation of oxychlorides. In order to obtain tungstic acid pure and free from sodium, it was found necessary to convert the acid from commercially "pure tungstate of sodium" into the ammonium compound, which was then repeatedly crystallised: the presence of even a trace of sodium is easily detected in tungstic acid, as when ignited it acquires a green tinge from formation of some lower oxide of tungsten, whilst the acid in a pure state is of a yellow colour without any shade of green. The vapour density of the hexachloride taken at 440° gave numbers considerably too low for the atomic weight 184, whilst, at 350°, the results correspond to it, showing that at the higher temperature dissociation or decomposition took place, which was confirmed by the fact that when the hexachloride was heated to a high temperature in a current of carbonic anhydride chlorine was given off. This tungsten compound may be crystallised from carbon disulphide, and is not deliquescent when quite free from the pentachloride and oxychlorides. The pentachloride WCl_5, which is also a crystalline solid, was obtained from the hexachloride by heating it in a current of hydrogen, and then distilling off the volatile pentachloride from the non-volatile tungsten compounds containing less chlorine formed at the same time. Tungsten tetrachloride and tungsten dichloride are not crystallisable. Tungsten oxychloride, $WOCl_4$, and tungsten dioxychloride, WO_2Cl_2, both crystalline compounds, have been known for some time; the former forming scarlet needles and laminæ; the latter is pale yellow. Professor Roscoe has also examined the two bromides, the pentabromide and the dibromide, and believes that a tribromide, WBr_3, exists, although he has as yet been unable to isolate it. Tungsten pentabromide was most conveniently prepared by passing carbonic anhydride saturated with bromine vapour over heated metallic tungsten. It forms very dark coloured crystals, which undergo slight decomposition when kept, bromine being liberated. The dibromide is not crystalline. He had also prepared and examined the dioxybromide, WO_2Br_2, the oxybromide, $WOBr_4$, a substance crystallising in red needles, somewhat resembling potassium chlorochromate, and the diiodide, WI_2, which is the only iodine compound of tungsten he had succeeded in obtaining. From numerous analyses of these different compounds, and from vapour density determinations, Dr. Roscoe has succeeded in establishing that tungsten is a hexad, and from careful determinations with the hexachloride has found the atomic weight to be 184·04; tungstic acid being exceedingly difficult to obtain in the pure state gave a slightly lower number. A series of very fine specimens of the substances we have mentioned were exhibited.

The President said the thanks of the Society were due to Dr. Roscoe for having so satisfactorily fixed the formulæ of these tungsten compounds by analyses and by determination of their vapour densities: many of the elements and their compounds were like small islands in a vast ocean, which had only, as it were, been observed from a distance, and never thoroughly explored, and this might, perhaps, be said of nine-tenths of the substances with which we profess to be acquainted. There would appear to be no doubt that tungsten was a hexad from the careful examination which had been made of the hexachloride, but thought there must be something behind in the case of the pentachloride and pentabromide which were abnormal. It would be very satisfactory if this could be cleared up.

Dr. Williamson desired to know whether Dr. Roscoe had obtained the pentachloride without the employment of hydrogen.

Professor Roscoe replied that the splitting up of the hexachloride under the influence of heat showed that the pentachloride could be formed without the use of hydrogen; moreover, the highest tungsten compound of bromine known, the pentabromide, which was quite analogous to the pentachloride, was formed directly from tungsten and bromine without the intervention of hydrogen.

The President then adjourned the meeting until Thursday, March 7th, when Dr. Debus will read a paper on "The Reduction of Ethyl Oxalate by Sodium Amalgam."

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 6th, 1872.

E. W. Binney, F.R.S., F.G.S., President, in the Chair

Mr. Sidney Jewsbury was elected an ordinary member of the Society.

Dr. Joule, F.R.S., called attention to the very extraordinary magnetic disturbances on the afternoon of the 4th instant, and from which he anticipated the aurora which afterwards took place. The horizontally suspended needle was pretty steady in the forenoon of that day, but about 4 p.m. the north end was deflected strongly to the east of the magnetic meridian, and afterwards still more strongly to the west. The following were the observations he had made.

Time.	Deflection from the Magnetic Meridian.	Time.	Deflection from the Magnetic Meridian.
4.0 p.m.	0° 50′ E.	6.10 p.m.	1° 24′ W.
4·30 ,,	0 47 W.	6.12 ,,	1 8 ,,
4·55 ,,	2 22 ,,	7·41 ,,	0 10 ,,
4·58 ,,	3 0 ,,	7·43 ,,	0 0 ,,
5·9 ,,	3 45 ,,	8.9 ,,	0 42 ,,
5·12 ,,	0 52 ,,	8.31 ,,	0 10 ,,
5·23 ,,	5 36 ,,	8.54 ,,	1 18 ,,
5·24 ,,	2 28 ,,	8.58 ,,	0 52 ,,
5·35 ,,	0 52 ,,	11.3 ,,	0 5 ,,
5·55 ,,	0 52 ,,		

Mr. Sidebotham states that he also expected the magnificent aurora, on account of the violent disturbance of the needle at Bowdon, amounting to at least 3°. Observation with the spectroscope by Dr. Joule showed a bright and almost colourless line near the yellow part of the spectrum. This line appeared to whatever part of the heavens the instrument was directed, and could be plainly seen when the sky was covered with clouds and rain was falling. When looking at the most brilliant red light of the aurora a faint red light was seen at the red end of the spectrum, and beyond the bright white line towards the violet end two broad bands of faint white light.

Mr. Thomas Harrison stated that he saw the aurora on last Sunday evening from 6 hrs. 15 min. to 9 hrs. 30 min., and took spectroscopic observations thereon from various parts of the sky. In each case, however, he discovered only one bright yellow line, situated between D and E, being on Kirchhoff's scale about 1255 to 1260. He is not acquainted with any known substance that gives a corresponding line. The line throughout was very clear and decided both in the narrow and wide slit; but he failed to discover any continuous spectrum. The line was also very perceptible by reflection from those parts of the sky in which no trace of the aurora was visible; and although the streaks were both red and white, the spectroscope appeared to give the aurora as a mono-chromatic light.

"*Note on the Destruction of St. Mary's Church, Crumpsall, on the 4th of January*, 1872, *by Fire from a Lightning Discharge*," by Joseph Baxendell, F.R.A.S.

The interest taken in the question as to the cause of the recent accident by lightning to St. Mary's Church, Crumpsall, induces me to submit to the Society the following results of a careful examination of the lightning conductor, spouts, gas-piping, &c., at the church and rectory, which I made on the 27th ultimo.

The lower part of the conductor passes through an iron down-spout, and terminates in a common drain pipe at a distance of only 3 feet 9 inches from the lower end of the spout, and at a depth of only about 18 inches below the surface of the ground. It has, therefore, no direct connection with the earth, and is, in consequence, absolutely useless for the purpose for which it was intended. The iron down-spout through which the conductor passes received the end of a lead gutter, which extended the whole length of the church to the top of a similar iron down-spout built in the wall inside the rectory, and connected with another iron spout outside the wall by a leaden bent pipe. This leaden bent pipe was above the floor of the vestry, and at a distance of 18 inches from it, and below the floor, there was a lead gas-pipe connected with the large gas-meter, which received its supply from a main laid in the street leading to the rectory. There was a small meter under the tower, but no part of the piping connected with it approached the conductor, the spouts, or the lead gutter, within a less distance than 3 feet.

Assuming, then, that the lightning struck the top of the conductor, its course would be through the lead gutter to the iron down-spout in the vestry, and then by a disruptive discharge from the lead bend to the lead gas pipe under the floor of the vestry and through the meter to the street main. The lead gas pipe would be melted and the gas ignited, and it is very probable that the disruptive discharge from the lead bend would also ignite any inflammable materials that might be in that corner of the vestry.

When the discharge arrived at the gas main in the street, part of it would pass down the main in a westerly direction and part up the main to the supply pipe and meter at the rectory. Here a small lead pipe passed from the meter for a short distance along the ceiling of the cellar, and in its course came in contact with an iron water supply pipe; the discharge melted part of the small lead pipe, ignited the gas, and finally passed off through the water supply pipe into the main in the street.

I have assumed that the lightning struck the top of the conductor, but I must state that I was unable to discover the slightest trace of any action tending to support this view; and it is at least equally probable that the stroke fell directly on the top of the iron down-spout at the east end of the church. It is stated that the bell in the tower was heard to ring at the time of the discharge; but the mere passage of the electric fluid down the conductor would not affect the bell, and the concussion of the air from a discharge on the top of the conductor would act upon the tower in a vertical direction, and would not, therefore, be likely to give the bell a swinging movement. If, however, the discharge was directly on the spout at the east end of the church, then the concussion of the air would act laterally upon the tower in an east and west direction, and, as the bell swings on an axis lying north and south, it is quite conceivable that an oscillating movement might be given to it sufficient to cause it to ring. In either case, however, whether the discharge took place upon the top of the conductor or on the top of the down-spout in the vestry, the ultimate results would be precisely the same. Had the conductor been directly connected with the gas main, as suggested by Mr. Wilde, the accident to the church would have been prevented, but not that at the rectory. The practical conclusion, therefore, to be drawn from a consideration of all the circumstances of this disastrous occurrence is that, in towns and districts where systems of gas and water mains and pipes exist, all lightning conductors should be directly connected with the mains of both systems. Had this been done at St. Mary's Church no accident would have occurred either to the church or the rectory.

Mr. Boyd Dawkins, F.R.S., called the attention of the Society to a remarkable group of crystals of calcite and sulphide of iron surrounding stalactitic bitumen, found at Castleton in Derbyshire, by Rooke Pennington, Esq. The mode of formation was this. When the mountain limestone of that district became charged with bitumen, the latter penetrated into a cavity which it traversed in long stalactite drops. Subsequently the cavity was more or less filled with crystals of calcite and sulphide of iron, which were deposited by the water charged with those substances around the drops of bitumen. The heat by which the bitumen found its way into the rocks must have disappeared before the crystals were formed; for had the latter been the result of hydrothermal action, they may have been coated, but certainly could not have been traversed by the solid bituminous stalactites.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Monday, February 12th, 1872.

Dr. William Wallace, F.R.S.E., President, in the Chair.

Mr. R. F. Smith read a paper "*On the Utilisation of the Waste Substances in Gas Liquor.*"

The author dwelt at considerable length on the efforts made from time to time to render the nitrogen of the atmosphere available for the supply of the ammonia and cyanogen required in ever-increasing quantities in the arts. He referred to the fact of Fownes and James Young having demonstrated, in the year 1841, the possibility of causing nitrogen to yield cyanogen by passing it over red-hot charcoal obtained from pure sucrose mixed with potassic carbonate. The compound obtained was potassic cyanide. Bunsen repeated and confirmed the experiments; and soon after his results were published two Frenchmen started an establishment at Grenelle, near Paris, for the purpose of producing cyanides on a great scale. They did not succeed in making the undertaking pay, nor did they succeed when they afterwards attempted it in England. Other experiments were tried upon a large scale with the view of manufacturing potassic ferrocyanide without animal matter, for which the nitrogen of the air was the substitute. Alkalised charcoal was used as in the former experiments. This undertaking was also abandoned after the loss of many thousands of pounds. Other manufacturing attempts were subsequently made, and they were so unsuccessful that it was suspected that the ammonia of the atmosphere or the nitrogenous constituents of the coal, rather than free nitrogen, formed the source of the cyanogen; and a process was proposed and patented for the manufacture of ferrocyanides by passing the gases evolved during the carbonisation of animal matter over alkalised carbon at a red heat. The ammonia in this instance was partially converted into ammonic cyanide and marsh gas. Dr. Lunge, who worked this process on the manufacturing scale, found acetylene among the waste gases in marked quantity. The ammonic cyanide was passed into ferrous sulphate solution, and the precipitate, treated with potassic carbonate, yielded the desired ferrocyanide. This is a manageable method of procuring cyanides, and might be used with advantage if ammonia could be cheaply obtained. The author referred to the advantages and disadvantages, respectively, of using potash and soda in these experiments, and suggested baryta for use instead, as its cyanide is formed at a low temperature, the base is infusible and non-volatile, and it can be procured in any quantity. After speaking of other methods, including that of Schwartz, which involves the use of copper or iron filings exposed at a red heat to the action of a current of carbon disulphide and ammonia gases, he referred to the production of alkaline cyanides in blast-furnaces using raw coal and the hot blast, embracing a notice of the observations and experiments of Dawes, Zinken and Bromeis, Redtenbacher, and Bunsen and Playfair. At the Portland Ironworks, near Kilmarnock, one of the furnaces, in the year 1865, produced for some time upwards of half a ton weekly of a saline mass containing cyanogen from leaks in the neighbourhood of the tuyeres. Some specimens were of great beauty, being invariably pure white mottled with pink-coloured veins. One botryoidal mass weighed upwards of 50 lbs., and was secured for the Pharmaceutical Society's Museum in London. The air around the tuyeres was impregnated with the odour of the cyanide. None of the other furnaces produced the compound, and the one in question, on being blown out and repaired, also ceased to do so. Mr. Smith analysed many specimens of these furnace products at the time, and found them to contain from 3 to 19 per cent of cyanogen; and what seemed new to him was the presence of lithia in weighable quantity, as much as 0·75 per cent being got from one specimen, of which the following is an analysis:—

Potassic cyanate	21·45
„ carbonate	1·34
„ silicate	0·98
„ sulphate	0·41
„ cyanide	47·73
„ sulphide	1·61
„ chloride	0·74
Potassa	10·13
Soda..	7·19
Lithia	0·74
Graphite	4·50
Insoluble residue, fixed at low red heat	1·32
	98·14

Graphite, the author remarked, is generally present in these blast-furnace cyanides, and is probably a product of the decomposition of the cyanogen itself, and probably, also, is the graphitoidal carbon which separates so plentifully in scales from certain kinds of pig-iron while cooling and becoming solid. Another remarkable cyanide occurring in blast-furnaces is that of titanium, found in the hearth in the shape of beautiful copper-coloured cubes, which were proved by Wöhler to be titanium cyanide and nitride. Some Irish iron ores contain as much as 10 per cent of titanic acid, and from the remarkable power which the metal possesses of absorbing and combining with nitrogen some special *rôle* seems provided for it in the chemistry of the future. The preparation of ammonia and cyanogen salts may be said to go hand in hand, so intimately related are the two classes of compounds. Those of cyanogen so easily yield ammonia, and ammonia within certain limits is so easily transformed into compounds of cyanogen, that every improvement in the preparation of the one class of compounds must exert a marked influence on that of the other. No method of forming ammonia from its elements has yet been turned to practical account. It is detected in the collected products resulting from the combustion of phosphorus, carbon, metals, &c. Many cyanides are decomposed when superheated steam is passed over them, ammonia being one of the products. Barium cyanide especially is very easily acted on in this way; all its nitrogen is given off as ammonia, and baric carbonate is left behind. Beet-root residues yield salts containing sometimes as much as 1½ per cent of cyanides. Referring to the varied applications of ammonia and its compounds, and to the rapidly increasing use of the sulphate in agriculture, the author devoted some consideration to the question of returning the nitrogen to the earth which is removed from it in the form of food, and stated that all the present supplies of ammonia are, or may be said to be, procured by the destructive distillation of animal or vegetable substances, as in the production of bone charcoal for the sugar refiner, and in the distillation of coal and shale in the manufacture of coal-gas and paraffin oil. Of late years, the production of gas tar has relatively diminished, while that of ammonia has relatively increased, and the methods of recovering it have been improved. The high temperatures now employed in gas making transform most of the nitrogen of the coal into ammonia, instead of converting it in considerable quantity into compounds of the pyridine and related series, as when very low temperatures were employed. A large quantity of ammonium carbonate and ammonium cyanide might be obtained from the vitriol tar of the mineral works if it were properly treated; and ammoniacal liquor of much greater strength might be obtained by gas managers if they were to wash the gas more thoroughly. By using the liquor as a shower, in the proportion of 1 vol. to 18 of gas, the liquor might easily be raised to 10° or 11° of Twaddell's hydrometer, while at present the average strength is rarely above 5° as obtained from the gas tanks. Ammonium dicarbonate is the salt present in largest proportion in gas liquor; a saturated solution of it sometimes gets entangled with the heavy tar in the bottoms of the tanks and in the condensers of gas-works. It is difficult or impossible to pump it, and when the tanks are cleaned out (perhaps once a year) tons of it are often got and thrown away by gas managers among the fuel, so little do they know of its value. Even many tar distillers are ignorant of its value, and they often set it down as naphthaline, and consequently of but small account. When the crystals are washed with oil they are ready for saturating with acid. A sample analysed by the author yielded—

Ammonia	20·07
Carbon dioxide	54·21
Water, with tarry matter and some sulphocyanogen (by difference)	25·72
	100·00

The same salt was noticed by two German chemists, and by them said to be of rare occurrence; but, according to Mr. Smith, it is not at all rare. The hydraulic mains of gas works are not often cleaned, but occasionally an extraordinary deposit of sal-ammoniac is found in them. It is of the fibrous nature of the sublimed compound of commerce. The general method of treating the gas-liquor in Scotland is to pump it into a boiler and distil off the volatile ammonia into sulphuric acid, continuing the operation as long as any strong odour of ammonia clings to the liquor. The spent water is then got rid of as speedily as possible, and the boiler re-filled. This method gives a good light-coloured sulphate with a little free acid and a mere trace of fixed matter on ignition. In some factories the Coffey still is used for continuous distillation, but it has not met with much favour, although, in certain cases, it has been adopted with success. The author also referred to a process for economically recovering sulphur from the sulphides present in gas-liquor, to the presence of ammonium sulphocyanide. This compound has been used for photographic purposes, and the author said that if any demand should arise for it any amount could be got from the spent water of the ammonia works by simply evaporating it and purifying the salt. When heated till decomposition ensues, the remaining residue is the curious substance known as mellon, the chemical history of which requires some clearing up. After all the present demands for this salt are supplied the residue is generally discharged as worthless; even the contained ammonia is but rarely recovered. In the author's opinion there is enough of this compound to produce all the yellow and red prussiates required in the arts. The chief difficulty, at first sight, is the immense volume of water requiring to be evaporated; but with cheap fuel or an abundance of waste heat, this might easily be overcome. The concentrated liquor is evaporated with sufficient potash solution to drive off the ammonia, and recovering it in the usual way. After being completely dried, the saline mass is mixed with iron filings or spongy iron and heated for a short time in a closed iron vessel. The sulphocyanide of ammonium is resolved into potassic ferrocyanide and potassic and ferrous sulphides:—

$$6KCNS+12Fe=2[K_2Fe(CN)_3]+K_2,S+5Fe_2S.$$

On treating the mass with water the ferrocyanide dissolves, and may be separated from the ferrous sulphide by filtration; it is afterwards separated from the potassic sulphide by crystallisation, the sulphide remaining in the mother-liquor.

Mr. Smith mentioned that he had been for some time engaged in an attempt to perfect this process, and that the results of his laboratory experiments promised fair.

CORRESPONDENCE.

THE NESSLER TEST.

To the Editor of the Chemical News.

Sir,—A hint, if even a small one, may prove valuable in these busy days, when so many are practically pursuing our beautiful science of chemistry, and when, perhaps, some pursue it "*con amore*" who cannot afford to waste time, and who are mainly dependent upon their own resources and guidance. I have a hint I wish to give concerning Nessler's useful test. Our text-books tell us how to prepare this test, but afford but very slight information as to any precautions that are needful to be observed in its practical use, and in the deductions to be made therefrom. For instance, in the presence of soluble Mg compounds in water or of those of Fe, while they do not prevent, but on the contrary increase, the amount of precipitate produced on the addition of Nessler's test, such precipitate affords no clear evidence by which we may judge of the presence or absence of ammonia. For instance, magnesium compounds would furnish a white precipitate with Nessler's test by which any red ammonium precipitate produced would be disguised. Ferric compounds would precipitate ferric oxide, and this might be mistaken for the red ammonium compound. Caution should be exercised therefore in using this test, especially in the examination of potable waters, a practice which is becoming daily more needful, and one which is likely alone to resolve the unhealthy condition of many homes and of those who reside in them. Nessler's test is generally resorted to as a means of determining readily the presence or absence of ammonia; we see this cannot be surely depended upon in its reactions unless the deductions made therefrom are framed with due precautions.—I am, &c.,

E. V. Gardner, F.E.S.

Laboratory, Berners College.

MISCELLANEOUS.

The Repetition of Experiments.—The importance of experimental investigation, so strongly insisted on by Bacon and practised since by scientists as the basis of the true scientific method in physical researches, is now so generally admitted as to need no argument. The importance of not accepting results as final determinations of physical laws until repeated experiments leave no room to doubt their accuracy, is not so generally appreciated. The really scientific investigator always retains some reservation in his acceptance of results attained by others, unless, through the most careful scrutiny, he can find no error in their method of experimentation, and can devise nothing which appears a more sure way of arriving at truth. The prestige of name and attainments goes far to influence belief, but those who think for themselves need a surer foundation than this in matters where accuracy is essential. Libraries of reference contain tables which are relied upon by engineers and constructors in making their computations, and in the use of which they cannot go far astray; yet many of them have been found in practice to be inaccurate. At least, recent experiments have given results differing more or less from those formerly obtained, and from which the tables were framed. As long as differences exist greater than may be accounted for by inaccuracies in manipulation, there must remain doubt as to the correctness of our knowledge. Experiments upon any subject should, then, never cease until a certain degree of uniformity is attained through the employment of different methods. There are not wanting recent illustrations of the truth of this proposition. Among these may be cited the remarkable experiments, of Professor Ogden W. Rood, of Columbia College, New York, on the amount of time necessary for vision, in which Wheatstone's conclusions from his experiments on the duration of the discharge of a Leyden jar, are found to be immensely far from the truth. He affirmed that the time necessary to produce distinct vision was within one-millionth of a second. Professor Rood now shows, by a most ingenious method, that in a space of time less than forty millionths of a second, the retina can receive and combine a whole series of impressions; and he feels confident that the eye could distinctly see an object illuminated during a period so inconceiveably minute as four billionths of a second. In the conclusion of his paper on this subject, published in the *American Journal of Science* for September, 1871, he quietly remarks: "All this is not so wonderful, if we accept the doctrine of undulatory light, for according to it, in four billionths of a second, nearly two and one half millions of the mean undulations of light reach and act on the eye." Professor Rood also has determined the possible duration of the discharge from a Leyden jar to be as short as nineteen hundred-millionths of a second. Even the experiments of Regnault have been recently revised by Mr. Alexander

Morton, with results from which he deduces formulæ that show the relation between the temperature, pressure, and density of steam. Recent experiments have shown room for doubt as to the full reliability of the tables in common use for computing the strength of beams and girders. Boiler explosions are now being brought under systematic experiment, at Sandy Hook, which will doubtless throw much light on this important subject. In short, there yet remain many things in science and mechanics to be definitely determined. The experiments of General Morin on friction might be revised, we think, with profit, and carried further than he went with them, to show how the compounding of motion on cylindrical surfaces modifies friction, and what part of the power is absorbed by friction in each of the components of the resultant. The use of air compressors has shown that we are far from knowing the real laws of the friction of gases in tubes; and herein is a most important and profitable field of investigation, as the use of air as a motive power in mines and tunnels is only in its infancy. But we have said enough to show that, notwithstanding the labours of those that have gone before, there is yet enough scientific work to be done.—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, January 29, 1872.

This number contains the following original papers and essays more especially bearing upon chemistry:—

Researches on Fermentation.—E. Fremy.—First portion of an exhaustive memoir on this subject, which has of late given rise to very grave discussions in this scientific assembly. The author's memoir is too lengthy to admit of any useful abstraction.

Observations Relating to the Processes of Preserving and Ameliorating Wine by Heating.—P. Thenard.—The main object of this paper is to prove that Appert is the inventor of this method, and that De Vergnette first made it practically applicable by fixing the limits of temperature to which the wine should be heated.

Note Relating to Researches on Dyeing made by P. Havrez, C.E., at the Professional School at Verviers (Belgium).—Professor Chevreul.—The venerable *savant* gives a detailed account of researches made, whereby the contents of his (Chevreul's) celebrated work ("Moyen de Définir et de Nommer les Couleurs d'Après une Méthode Précise et Expérimentale") have been turned to practical account, while P. Havrez also confirms what was stated to be the case (on August 7, 1826, by Prof. Chevreul), viz., that Prussian-blue becomes deteriorated.

Supersaturation of the Solution of Chloride of Sodium.—L. C. de Coppet.—The original paper has been sent to us by the author, and is given on another page.

Le Moniteur Scientifique Quesneville, No. 361, January, 1872.

This number contains the following original papers and memoirs bearing upon chemistry:—

Anthracen and its Derivatives.—Dr. E. Kopp.—The continuation of this very lengthy and exhaustive monograph. This portion contains the following sections:—Derivatives of anthrachinon; bibrom-anthrachinon, $C_{14}H_6Br_2O_2$; monobrom-anthrachinon—

$$C_{14}HgBr(O)_2'';$$

action of nitric acid on anthracen and its derivatives; mononitro-anthracen, $C_{14}H_9NO_2$; dinitro-anthrachinon and its derivatives; action of nitrous acid upon diamido-anthrachinon. To be continued.

Action of Oxygen upon an Alkaline Solution of Alizarine.—Dr. Auerbach.—Reserved for translation.

Adulteration of Sugar with Dextrin.—Dr. C. Scheibler.—The main results of the author's researches on this subject (the adulteration relates to raw unrefined sugar) may be summarised as follows:—The presence of dextrin in unrefined sugar very considerably increases the degree of optical rotation of the sugar. The dextrin may be detected by the action of alcohol upon the sugar solution, by producing therein a gelatinous precipitate or a perceptible turbidity; further, by the colouration with iodine solution; by the impossibility of perfectly clarifying a solution of such sugar with acetate of lead; by the difference of polarisation before and after inversion; and, lastly, by the absorbing action which animal charcoal exerts upon dextrin.

We are glad to find in this number the projected statutes (bye-laws) of—

A French Association for the Advancement of Sciences.—A number of eminent scientific men, assisted by some who take an interest in the advancement of sciences and the spreading of sound useful knowledge, have, it appears, come to an understanding and terms upon which shall be based this new scientific institution, to which we sincerely wish "Quod bonum felix faustumque sit," and useful to the nation which has undoubtedly largely contributed to the immense store of knowledge which the civilised world now possesses.

Bibliography.—Under this heading we announce "Etude sur les Quinquinas," par Pierre-Paulin Carles; an octavo volume published by Baillière, and full of very valuable and well arranged information on this subject, including the methods of analysis of the barks as well as of the ash they yield on being incinerated.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 2, 1872.

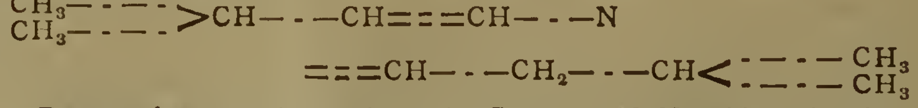
This number contains the following original memoirs and papers:—

Contribution to our Knowledge on Spectrum Analysis.—K. Vierordt.—The contents of this memoir, illustrated by diagrams, are, notwithstanding the very high intrinsic merits, not suited for useful abstraction.

Oxidation of Ketons, a Means of Determining the Constitution of Acids and Alcohols.—A. Popoff.—In the first portion of this paper, the author quotes some particulars taken from a work, edited by him and published in the Russian language, on the general rules relating to the oxidation of the ketons. When ketons are selected in which one of the alcohol radicals combined with carbonyl is phenyl, methyl, or ethyl, then, by the oxidation, the carbonyl remains combined with this alcohol radical, while the other alcohol radical becomes oxidised, and, if that other radical is that of a normal alcohol, the result is the formation of a normal acid; if, on the other hand, it is an an iso-alcohol radical, an iso-acid is formed, while a secondary alcohol radical yields an aceton, and, as for a tertiary, it becomes split up. The greater portion of this essay is devoted to the exhaustive description of a series of experiments made with the view of testing the correctness of the views above given.

Preliminary Communication on Amido-Benzol-Sulpho Acid.—H. Rose.—The nitro-benzol-sulpho acid, obtained by treating nitro-benzol with fuming sulphuric acid, yields an amido-benzol-sulpho acid, which, when in dilute solution, imparts an intense yellow colour to fir-wood, and exhibits (viz., the aqueous solution) a very characteristic reaction with chloride of copper under the following conditions:—The chloride alone does not give any reaction with the aqueous acid fluid; but, when simultaneously some chloride of ammonium and ammonia are added, when the liquid is boiled, a deep red colouration of the fluid ensues; when it is treated with sulphuretted hydrogen for the purpose of eliminating the copper, the colouring substance becomes reduced, and the colouration of the solution thereby converted to a brownish hue; but, by oxidation in contact with air, the red colouration is restored, and, on evaporation of the liquid on the water-bath, there is, along with chloride of ammonium, left the pigment, which is readily soluble in water and alcohol, but insoluble in ether and benzol. This pigment is destroyed by chloride of tin and nitric acid, but is soluble in strong sulphuric acid without any change. The author is engaged with further experiments on this subject, and also on a different nitro-benzol-sulpho acid and amido acid derived therefrom.

Further Researches on Artificial Coniine.—H. Schiff.—This essay opens with the detailed description of the method of preparation of coniine by artificial means, starting with butyraldehyde exposed to direct sunlight for several months along with alcoholic ammonia solution kept in a well-stoppered bottle. The artificially-obtained alkaloid is, as regards its physiological action, akin to the natural coniine obtained from *Conium maculatum* and *Cicuta virosa*. The boiling-point is from 168° to 170°, and also that of the native; the specific gravity varies from 0·893 to 0·899 at 15°. The main difference, as regards the properties of the native and artificially-prepared coniine, is that the latter does not exhibit any optical rotatory action. Constitutional formula—



$$\begin{matrix}CH_3\text{---}\\ CH_3\text{---}\end{matrix}>CH\text{---}CH{=}{=}{=}CH\text{---}N$$
$$={=}{=}CH\text{---}CH_2\text{---}CH<\begin{matrix}\text{---}CH_3\\ \text{---}CH_3\end{matrix}$$

Researches on the Uric Acid Group.—M. Nencki.—After first briefly referring to his former researches on this subject, the author states that the formula of the body formed by the action of sulphuric acid on sulpho-pseudo-uric acid is $N_4C_5SO_2H_4$. This new acid has been named uro-sulphinic acid; the potassa salt of this acid yields large-sized well-defined crystals. The acid is monobasic and a very weak one, being decomposed by carbonic acid. The constitutional formula of this body, which is rather stable and resists desulphuration, cannot as yet be made up.

Observations on Dr. Flückiger's Communication on the Occurrence of Pyrocatechin in Kino.—Dr. von Gorup-Besanez.—This paper contains a rectification of an error made by Dr. Flückiger (see Chemical News, vol. xxv., p. 57) in reference to the author's paper, quoted in the work just alluded to, the gist of the matter being that the pyrocatechin in kino is derived from the living plant, because in the *Butea* kino, prepared it appears at a rather high temperature the pyrocatechin is absent.

Meaning (Bedeutung) of the Atomicity of the Elements.—A. Michaelis.—An algebraical essay.

Some Derivatives of Benzol.—V. Meyer and O. Stüber.—The first part of this essay treats on the three modifications of dibrom-benzol, *resuméd* in the following manner:—

Dibrom-benzols.	Fusing-point.	Boiling-point.	Behaviour with Nitric Acid.	Mono-nitro Derivative.
Couper's (1,4)	+89°	219°	Dissolves by the aid of heat	Foliated or needle-shaped crystals fusing at 84°
Reise's (probably 1,2)	-1°	From 213° to 215°	Dissolves in the cold with evolution of heat	Small needle-shaped crystals fusing at 58°
Meyer and Stüber's (probably 1,3)	Fluid at -28°	About 215°	Dissolves by the aid of heat	Needle-shaped crystals fusing at from 60° to 61°

The second part of this essay treats on dibrom-aniline, obtained by treating pure dibrom-benzol first with fuming nitric acid, next precipitating with water, washing upon a filter the nitro-product obtained, and reduction of that body by means of tin and hydrochloric acid. The base thus obtained, dibrom-aniline, is a solid beautifully-crystallised body, but difficultly forming salts, all of which are very prone to decomposition, the acids being only loosely fixed to the base.

Butylen-Glycol, a New Product of the Condensation of Aldehyde.—A. Kekulé.—In the lengthy purely-speculative introduction to this paper, the author observes that it would be interesting to obtain a body bearing to acetaldide the same relation as hydrobenzoin to benzaldide, since such a body would be a bivalent alcohol, a butylen-glycol, $C_4H_{10}O_2$. By a series of difficult and rather complex as well as circuitous experiments, the author has obtained such a body, a very limpid thickish fluid, akin to glycol, exhibiting a sweetish slightly acrid taste, boiling at from 203·5° to 204°, readily soluble in water and alcohol, but not so in ether; formula, $C_4H_{10}O_2$. The remainder of this essay treats at great length on the oxidation products of this substance, these researches having been undertaken with the view to ascertain the constitutional formula as well as to verify the nature of this new body, but, since this part requires for its due understanding the reproduction of a large number of complex formulæ, we do not enter into further details on this subject.

American Journal of Pharmacy, February, 1872.

In addition to several valuable papers on pharmacy, this number contains the following original papers and memoirs bearing upon chemistry:—

Pepsin: a New Practical and Reliable Method to Prepare it; its Properties and Digestive Strength.—E. Scheffer.—This lengthy memoir contains a detailed and practically available account of the author's exhaustive experiments on this subject, from which we summarise the following:—Preparation of pepsin: the mucous membrane of a previously well-cleaned hog's stomach is dissected off, chopped finely, and macerated in water acidulated with hydrochloric acid for several days, during which time the mass is frequently well stirred; the resulting fluid is strained, and, if not clear, set aside for twenty-four hours, in order to allow the mucus to settle. To the clarified liquid, a thoroughly saturated solution of chloride of sodium is added, and the whole thoroughly mixed. The pepsin, separated from the rest of the solution by the addition of the saline solution, is found floating on the surface of the fluid, and is removed with a spoon, put upon cotton cloth to drain, and finally submitted to strong pressure, to free it as much as possible from the salt solution. The air-dry pepsin is a very tough substance, and presents according to thickness a different appearance—resembling in thin sheets parchment-paper, and in thick layers sole-leather; its colour varies from a dim straw-yellow to a brownish yellow. Besides a little mucus, it contains a small quantity of phosphate of lime and chloride of sodium. In order to purify the pepsin thus obtained still further, it is again dissolved in acidulated water, filtered through paper, again precipitated with a solution of salt, and again further treated as above mentioned. Recently precipitated pepsin is very soluble in water, but when once air-dry it dissolves but slowly, and only in small quantities, in that liquid. The aqueous solution has a neutral reaction, is coagulated by boiling, and yields with alcohol a transparent gelatinous precipitate. With sulphate of copper it remains at first clear, but after several hours becomes turbid; with bichloride of mercury, a white precipitate is immediately formed. Tannin, as well as nitrate of lead, forms white precipitates. The precipitate formed by adding chloride of sodium to an aqueous, not too concentrated, solution of pepsin, exhibits at first a jelly-like transparent appearance, which disappears upon stirring, the liquid acquiring a slightly opalescent appearance; after a short time it becomes more turbid, and small flakes are noticed floating in it, which will soon form into small transparent globules, and as such rise to the surface. When the quantity of pepsin in a liquid is very small, the opalescence and turbidity are hardly noticed, but after some time the small globules will appear on the surface. The aqueous solution of pepsin is readily decomposed, and, after the fourth day of having been made, emits a disagreeable odour, while small flakes separate from the clear solution. The aqueous solution of pepsin shows very little action on coagulated albumen, but the latter dissolves readily after the addition of a few drops of hydrochloric acid. An acidulated solution of pepsin (1 fluid ounce of water containing 1 grain of pepsin and 2 drops of hydrochloric acid) gave rise to the following reactions:—By boiling, the clear liquid becomes turbid, and, upon cooling, deposits flakes; addition of alcohol, clear at first, but, upon standing, pepsin in the shape of flakes is deposited; strong hydrochloric acid produces slight turbidity, which disappears by the addition of more acid or by dilution with water; chloride of sodium gives the characteristic precipitate; bichloride of mercury produces opalescence; tannin forms a heavy precipitate soluble in HCl; gallic acid, no action; carbonate and bicarbonate of soda produce a precipitate soluble in excess; a solution of carbonate of soda cautiously added to a solution of pepsin produces a precipitate which, upon being separated from the liquid, will prove to be pepsin again, but a little more carbonate of soda will re-dissolve it again, and the liquid no longer contains pepsin, which is then destroyed, as far as is concerned its power of dissolving, after acidulation with HCl, freshly coagulated albumen. The author further treats at length on the digestive power of pepsin; on pepton, that is to say, the albumen dissolved and digested by pepsin; on the digestive power of pepton; action of pepsin on milk; and on the incompatibility of alcohol with pepsin.

New Dye-Stuff.—Dr. J. M. Merrick.—Under this heading the author speaks of flavine, also sold under the name of aurantine, and which, according to reliable information, is a preparation of quercitron bark, well known in Europe, and manufactured in the United States by a process kept secret. According to the researches made by Drs. Bolley, Brunner, and König, flavine is sometimes nearly pure quercitrine, sometimes quercetine, and usually a mixture of the two. By dissolving the dye-material contained in quercitron bark in an alkaline solution, and next treating it with sulphuric acid, Hochstætter and Oehler have obtained a flavine-like substance.

La Revue des Scientifique de la France et de l'Etranger, February 3, 1872.

This number does not contain any original papers relating to chemistry, but we must not neglect to call special attention to the discourse published herein—

On Vital Force.—J. d'Omalius d'Halloy.—A very lucid and well-digested speech delivered by the celebrated Nestor of Belgian science just named.

The Tithionic (Geological) Deposit and the New German School.—E. Hébert.—A lecture on the chalk and limestone deposits.

February 10, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to the conclusion of—

Lectures on Anthropology.—Dr. A. de Quatrefages.—The portion here published is the more attractive and highly interesting as treating on quaternary man and his races; on the persistence of the quaternary man; his *rapport* with the now existing races; his part in the formation of modern peoples; and, lastly, on the Prussian race.

Bulletin de l'Academie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, No 11, 1871.

This number does not contain any original papers relating to chemistry, but we quote the titles of the two following essays:—

Experiment bearing upon the Question of the Vesicular Condition of Aqueous Vapour.—J. Plateau.

Second Paper on the Researches on, and Analysis of, Belgian Minerals.—Dr. L. E. de Koninck.

No. 12, 1871.

This number does not contain any original papers or memoirs relating to chemistry.

Journal für Gasbeleuchtung und Wasserversorgung, No. 1, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to a paper on—

The Hydrostatico-Galvanic Gas-Lighter.—Dr. Klinkerfucs.—This paper, elucidated by several large-sized engravings, contains the complete description of an apparatus wherewith a large number of gas-lights, including street-lamps, can be instantaneously and simultaneously kindled.

NOTES AND QUERIES.

Estimation of Nitrous Acid.—Would Mr. G. E. Davis say exactly how to proceed in testing nitro-sulphuric acid? What are the calculations which have to be made in order to get the percentage of N_2O_3? Has Mr. Davis compared his process with the urea process?—Discipulus.

Carbon-Trichlor-Bromide.—In the second number for January of your esteemed journal, I find an extract from the *Gazzetta Chimica Italiana* of Dec., 1871, in which the combination CCl_3Br is called by

Paterno a *new* combination. I prepared, although in an entirely different manner, the same combination long ago; I called it carbontrichlor-bromide, and obtained it by the decomposition of the trichlormethyl-sulfon-bromide, as described in 1869 in the *Zeitschrift für Chemie* (Oct.), and Chemical News, vol. xx., p. 276.—O. Loew, New York, Feb. 4, 1872.

Yellow Dye-Stuff.—There has recently been brought into the market here a new and excellent yellow dye-stuff called aurantine, and as it has, I believe, been sold and used in England, I should be glad to get some information concerning it through the columns of the Chemical News. As sold here it is a fine yellow powder; organic evidently in its origin, and does about as much work as 2½ times its weight in the best Persian berries, either in dyeing or printing. With a bath of 180° F. it gives flavine yellow on mordanted print cloth; with a heat of 212° a full deep orange. I shall be glad to hear from any English chemist who has tested aurantine.—J. M. Merrick, Boston, U.S.A.

MEETINGS FOR THE WEEK.

Monday, Feb. 26th.—Medical, 8.
—— Royal Geographical, 8.30.
—— London Institution, 4. Prof. Odling, F.R.S., "On Elementary Chemistry."
Tuesday, 27th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
Wednesday, 28th.—Society of Arts, 8.
Thursday, 29th.—Royal, 8.30.
—— Philosophical Club, 6.
—— London Institution, 7.30. Musical Lecture.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
Friday, March 1st.—Royal Institution, 9. Mr. C. W. Siemens, on "Measuring Temperatures by Electricity."
—— Geologists' Association, 8.
Saturday, 2nd.—Royal Institution, 3. Mr. Moncure Conway, "On Demonology."

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THE CHEMICAL NEWS.

Vol. XXV. No. 640.

ON THE
PRECAUTIONS WHICH SHOULD SURROUND TOXICOLOGICAL INVESTIGATIONS IN MEDICO-LEGAL CASES,
AND ON
EVIDENCE IN LAW COURTS.*

By Dr. ALBERT J. BERNAYS,
Professor of Chemistry at St. Thomas's Hospital.

I am happy to have an opportunity of bringing this subject before the Officers of Health of this great metropolis, as I cannot imagine a body of men more capable of founding a sound judgment upon it and of awakening the public mind to its importance. I little thought that such a commentary as that furnished by the cases of the Rev. Mr. Watson and Miss Edmunds would be offered, as it were, in illustration of the subject of evidence in courts of law. But these are so fresh in the thoughts of us all, that I feel myself relieved from the necessity of doing more than offering suggestions. Speaking, however, as a student of science, and with no authority on the subject of medicine, I shall commence by calling your earnest attention to the precautions which should surround toxicological investigations in medico-legal cases.

In the first place, I should say that in all cases of suspicion, where the symptoms call for enquiry, the post-mortem examination should always be conducted or witnessed by an expert, in addition to the local medical man. These two should settle between themselves, and *before commencing operations*, the *plan* of proceeding. Nothing should be left to haphazard. The portions of the body to be taken for analysis, provision made for the reception of these, symptoms carefully observed and noted; these are among the most obvious preliminary preparations.

But now as to the analysis. Who is to conduct it? Whatever our opinions may be as to the necessity of the work being performed by a medical man or a simple chemist, in this we shall agree, that the analysis should be carried out by a practiced hand.

Very few medical men, unless they devote themselves to the practice of chemistry, can trust themselves to execute an analysis, whatever their theoretical knowledge may be. In addition to this, it will also be granted that no medical men in full practice can find the necessary time for the work without neglecting their own more proper sphere.

It is for this reason I maintain that the analysis should be undertaken by one who is habitually experimenting. This precaution is as necessary with the chemist as with the chemical physician. It is quite as possible that the chemist may fail as the physician, for some chemists are only theoreticians, and quite incapable of executing with their hands the behests of the brain. If the work to be done is physiological rather than chemical, then the preponderance of the workers should be physicians rather than chemists. But one of my strong points is this, or, rather, I ought to say, one of the points I would wish to enforce is this—*The analysis should not be left to any one individual, whatever his talents may be.* The good chemist may be a bad microscopist and nothing of a physiologist. The good physician may be practically ignorant of chemistry, and, anyhow, may not have kept up the improved methods of analysis. So that we come to this: the work of thought and act should be carried out by three witnesses. Of these three, two should be experienced in analysis, and the jury of experts that I would select would be the local physician, a medical chemist, and a chemist. If there be not two practical men, then the present system might as well continue, for one good practical chemist could command the results, by carrying them out just as he wished.

Supposing, then, it be decided that the truth shall be established by the mouth of two or three witnesses; the work would be undertaken under a sense of responsibility which at present is very much wanting. Before even the vessels are opened, a consultation would have taken place as to what was to be done. And here comes in one of the great advantages of the scheme. The pure physician might say that he required a certain portion of the contents of the stomach, as a test of the wholesomeness or otherwise, to offer to some animal. The chemist might object on the score that such might not be injurious to an animal. Then the animal on which to experiment would be resolved upon; thus, if strychnine were the suspected poison, the frog would be the first thought; nothing would be left to accident, nothing to afterthought; every method of analysis would be settled, and every preparation made before the work was entered upon.

If we should then settle upon these preliminaries, an important question remains. Who are the physicians and chemists to be called in in such enquiries? And here I must be allowed to protest most vigorously against that principle of centralisation which has hitherto so much prevailed. Why should not the country be mapped out in the same way as at present in the case of coroner's districts. If a competent person reside in the district, it would not be unfair to the coroner to consider it his duty to call upon such person to perform the analysis. If this were a settled principle, there would be much more encouragement to men of science to settle down in different parts of the kingdom. Instead of all analytical work being given to two or three men, however able, the opportunities thus afforded would train up other men of experience. It is not consistent with common sense to say that A. is more experienced than B. if you never give B. a chance; all experience centres in A., and much of it dies with him. The similar assertion that B is not so well-known as A is self-evident; a person can never learn to swim if he never goes into water.

Supposing then these matters settled, or capable of arrangement, another matter occurs to me, for which I would venture to offer a solution. In certain cases, a dispute may arise between interested, not only as to whether poison has been given, but it may be the interest of one party to *prove* death by poison, and of the other to prove natural death. Such a case would be of rarer occurrence, and would probably be applicable only to animals. Let me adduce an illustration: An ox has been grazing in a field, it which it might, possibly, come by its death through metallic poison. If the event took place it would be the interest of the farmer to prove that the animal thus died; and equally would it be the interest of the mining agent to elicit the contrary fact. Now in a case like this, is the analysis to be left to one individual, and is judgment to be given according to his results? Let me show the fallacy of such an arrangement. It may be a trumped up case; the poison may have been put in beforehand; although such a thing may be of rare occurrence, it has already happened, and may happen again [case stated].

This would show the necessity for some different arrangement in the method of analysis. The interests of both parties would be provided for, in that the results of the analysis would depend upon the evidence of three witnesses.

Another question arises. Is it advisable to give to the chemists engaged any information as to the nature of the suspected poison and as to the medicines which may have

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* Read before the Medical Officers of Health, Feb. 17, 1872.

been given? I cannot help thinking that it would be desirable, as well as a matter of expense as of actually preventing an arrival at incorrect conclusions. In the first place, it would be a saving of expense, as in most cases the labour involved would be lessened. In the second place, it might prevent the finding of the real poison by the discovery of a medicine which in overdose alone would be a poison. Speaking to men of science, I will not enlarge upon these points, as your own experience will immediately fill up the gaps which I intentionally leave for you.

And now comes, perhaps the most important question, How is the evidence to be given?

I confess when I hear that the evidence which I shall give shall be the truth, the whole truth, and nothing but the truth, my heart sometimes fails me. I may give an illustration of personal experience, but there is really no occasion. Any one of us who may have been present in courts of law must have come away with the conviction that you may get plenty of law, but very scant justice. We know that in most cases the strife is for victory, rather than for truth. If we are rich, we can buy the best defence, whether scientific or otherwise. Indeed, we may be so wealthy that we can employ all the chief scientific witnesses, and therefore leave to our adversary no defence beyond what he can elicit through cross-examination. In what conceivable way can we admit that we tell the whole truth when we know that we go into the witness-box simply to tell *our* story? We may have heard from previous witnesses facts of which we had previously no knowledge, such as would have prevented us from giving evidence at all. The truth of our case depends too much upon the ability of our counsel either to suppress or overthrow evidence. I have seen a great case break down the moment the chief advocate left us; and I have seen the weakest case become strong through the able conduct of our adviser. As regards scientific witnesses, the great object of the lawyer is to confound them. If a timid man, the blustering "So you mean to say, sir" is quite enough to drive all the learning out of his head. The less a man knows, the more self assurance he possesses, and consequently the more esteemed is his evidence. "Give me a man as a scientific witness," said a leading police inspector, "who has no doubts." Can it, then, be wondered at that some men refuse to be sworn, and, consequently, to give evidence? I have a friend great in science, but I know that nothing short of a subpœna would ever induce him again to give scientific evidence in a court of law. From his great knowledge he makes a bad witness. He sees the bearings of questions, and naturally fences with them, so as not to compromise himself. But seat him at a table in a quiet room, with pen, ink, and paper, and you would not find a man who could better sift a case.

I cannot help thinking that the better mode of giving evidence, on the part of experts, would be in writing. I would give every possibility for *viva voce* examination on the part of the judge, and would allow counsel to suggest questions. But the conclusions the scientific witnesses have come to should be at once recorded in writing, and, as long as the barbarism is thought necessary, sworn to.

And in matters concerning the public health, of which you are the appointed guardians, do you not think that the proof, or otherwise, of a nuisance would be arrived at with greater certainty and with far less expense by a jury of experts than by the present system? How often does it not occur that more money is wasted upon witnesses than would be required to put chemical works into substantial repair! How frequently is undeserved ruin the penalty for the defence of unscientifically-conducted chemical works!

What, then, according to my imperfect view, is the conclusion of the whole matter?

(1). That greater safeguards should be established in obtaining evidence.

(2). That no chemical analysis involving life and death should be left to the discretion of one individual.

(3). That the selection of experts, whether medical or chemical, or both, should be made from a wider sphere.

(4). That the evidence of such men should be taken in writing and published before the trial, so that no one may be taken by surprise, and to give opportunities for the preparation of an answer.

(5). That the examination of scientific witnesses be entirely left to the discretion of the judges, and that counsel be only allowed to suggest questions to the judges, and not put them themselves.

(6). That in nuisance cases the matter in dispute be referred to seven men, medical and chemical, three to be selected on each side, the seventh to be appointed by both sides, and these seven to be exclusive of the medical officer of health, who has probably reported the case; and that only in case of non-agreement the matter be brought to public trial.

I have intentionally made short work of this paper, so as to give proper opportunity for debate. I believe the subject to be an important one, and the opinions, in part at least, are not new to many. But I am not conscious to have taken them from anyone, for I have held them and broached them many times for many years past. To us the question is alone pertinent, not Is it new? but Is it true? Let us regard it in that light, and deal with the matter, and not with the individual who brings it forward.

ON THE GASES CONTAINED IN COKE, AND ON THE APPLICATION OF THE SPRENGEL OR MERCURY AIR-PUMP TO THE ANALYSIS OF COKE.

By JOHN PARRY,
Ebbw Vale Iron Works.

It has always been a doubtful question with most chemists and metallurgists whether coal could be completely deprived by heat of its volatile constituents. The usual rule has been to expose the coal in a closed crucible to the heat of a gas or spirit blowpipe, and to assume the residue (after it had ceased to lose weight) to contain only carbon, and incombustible matter or ash.

Nevertheless, Dr. Percy and others have called attention to the fact that coke from the hardest burnt coals, on being subjected to elementary analysis, showed a loss of carbon. This loss might have been due to errors of analysis, but it was so constant that it has been generally assumed it is due to the presence of gaseous matter, by inference oxygen and nitrogen.

The author has, however, found that, contrary to the general opinion, coal persistently retains hydrogen, and even at the highest at his command (a Sefstrom's furnace) he has failed to entirely free coal from volatile matter; also that all kinds cannot be deprived of their volatile constituents with equal facility by merely heating in a closed crucible.

The writers attention was more particularly directed to this from the fact that he found great difficulty in freeing a sample of coal (sent to him for examination) from volatile matter. The coal was analysed with the following results:—

No. I. Coal.

Elementary Analysis.

Carbon.	Hydrogen.	Sulphur.	Ash.	Oxygen and Nitrogen.
65·600	4·243	0·807	5·170	24·180

Proximate Analysis.

Gas Coke.	Tar.	Water.	Illuminating Gas.
82·69	4·67	3·00	9·64

On heating 100 of this coal in a closed crucible at a heat which, from experience extending over many years, had always been found sufficient and to agree closely with results on the large scale* at the works, it gave 77·28 of coke; this not agreeing with the elementary analysis, several combustions were made, with results agreeing closely. It was therefore inferred the coke still contained volatile matter.

800 grs. of the gas coke was now heated to full redness in a small iron retort. Gas burning with a pale blue flame was rapidly given off for the first hour, then very slowly, and ceased in 30 minutes; total time, 1½ hours. Coke in retort weighed 759 grs.=5·2 per cent loss.

100 grs. coke from retort heated in closed platinum crucible (Griffin's gas furnace and large burner used) lost:—1·15 hours, 1·9; 3½ hours, 9·8; 1·40 hours, 12·9. Total loss, heated 6·25 hours=12·9 per cent.

20 grs. of the coal over large burner as above heated 4½ hours weighed 14·3; again 1·35 hours, 13·6; again 1·40, 12·8=coke, 64·00; loss, 36·00.

Analysis of Gas Coke.

Carbon.	Hydrogen.	Sulphur.	Ash.	Oxygen and Nitrogen.
84·360	0·187	0·850	8·300	6·303

Analysis of Coke Heated 7·55 hours.

Carbon.	Hydrogen.	Sulphur.	Ash.	O and N by diff.
89·450	trace	0·795	8·450	1·305

In order to further test the gas coke, 20 grms. were heated in a Sefstrom's furnace for 3 hours; lost 3·6 grms. =18·6 per cent loss.

20 grms. of the above heated coke heated *in vacuo* under the Sprengel pump for 2½ hours gave 7·664 centims. of gas, containing, per cent—

Carbonic Acid.	Carbonic Oxide.	Hydrogen.	Nitrogen by diff.
75·77	5·60	18·13	0·50

Volume of coke (measured), 15·4 c.c.

It now occurred to the author that it would be interesting to subject the gas coke to heat under the Sprengel pump, collecting and testing the evolved gases from time to time. 20 grms. used and heated 2½ hours gave 301·5 c.c. gas containing—

Carbonic Acid.	Oxygen.	Carbonic Oxide.	Hydrogen.	Marsh Gas.	Nitrogen.
22·80	0·00	13·49	50·00	13·80	0·00

Also water and tarry matter.

Again heated 7 hours, 586 c.c. gas, containing—

CO_2.	CO.	Hydrogen.	Marsh Gas.	N.
3·10	3·30	93·45	0·00	0·00

Again heated 1½ hours, 65·6 c.c. gas, containing—

CO_2.	CO.	H.
5·721	5·150	89·129 by diff.

Again heated 1½ hours, 80·00 c.c. gas, containing—

CO_2.	CO.	H.
4·800	5·110	90·090 by diff.

Again heated 1 hour, 62·5 c.c. gas, containing—

CO_2.	CO.	H.
9·65	0·70	89·65

Again heated 1 hour, 21·6 c.c. gas, containing—

CO_2.	Oxygen.	CO.	H.	N.
9·385	0·00	8·200	81·200	1·215

Total, 1117·2 c.c. gas from coke heated 14½ hours in glass tube in gas flame=about 72·5 volumes of coke used.

All the gas was not extracted, but in attempting to cool down the tube for next class experiments it cracked, and consequently spoilt the experiment. Taking, however, the previous trial of the coke heated in Sefstrom's furnace, it is pretty evident hydrogen is eliminated, leaving principally only carbonic acid.

A sample of a different vein of coal was now taken and examined.

No. II. Coal.

Elementary Analysis.

Carbon.	Hydrogen.	Sulphur.	Ash.	O and N by diff.	Coke.
73·688	4·956	1·826	7·300	12·23	63·50 p.c.

20 grms. of the coke under Sprengel pump—

		Gas.	Carbonic Acid.	Oxygen.	Carbonic Oxide.	Cyanogen.	Hydrogen.	Nitrogen.
		c.c.						
No. I.	Heated 2 hours	28	77·12	trace	4·153	0·00	0·000	17·780
	Again 2½ ,,	32	33·22	0·00	0·000	0·00	34·561	31·000
	4½ ,,	60						

20 grms. of coal again coked 4 hrs. 20 mins. in Sefstrom's furnace gave only 62·2 per cent coke (under Sprengel pump)—

		Gas.	Carbonic Acid.	Oxygen.	Carbonic Oxide.	Cyanogen.	Hydrogen.	Nitrogen.
		c.c.						
No. II.	Heated 1 hour	32·5	67·419	0·00	12·420	0·00	5·325	14·900
	Again 3 ,,	26·6	61·449	0·00	10·427	0·00	24·564	3·484
	4 ,,	59·1						

Vol. of coke, 20 grms.=16 c.c.=about 3·75 vols. of gas to 1 vol. of coke. Coke made from the above coal at the works, thoroughly coked sample taken, dried at a dull red heat, lost 0·933 per cent.

Dried coke under Sprengel pump 2 hours gave 51·5 c.c. gas containing—

Carbonic Acid.	Carbonic Oxide.	H and N.
91·400	3·583	5·017

Nos. 1 and 2 analyses differ, but the experiments were carefully made.

The coke from this coal differs from No. 1 in containing nitrogen, which appears to have been eliminated from No. 1 in previous coking. It is in good repute for iron smelting; No. 1 is never used, having been found unfit for use in the blast furnace.

Other samples of coke were now taken from the works and tested under the Sprengel pump, with the following results:—

Hard, well burnt coke; 20 grms., 2 hours under Sprengel pump, gave 79·2 c.c. gas, containing, per cent—

Carbonic Acid.	Carbonic Oxide.	Hydrogen.	Nitrogen.
85·720	8·590	5·680	0·000

Hard coke, mixed coals; 20 grms., 2 hours under Sprengel pump, gave 42·4 c.c. gas, containing, per cent—

Carbonic Acid.	Carbonic Oxide.	H and N. (Both present; H shown by explosion, but not separated)
57·413	28·562	14·025

Analysis of Coke.

Ash.	Sulphur.	Loss at Red Heat.	Loss under Sprengel pump.	Carbon by diff.
12·100	1·400	1·500	0·586	84·414

Common coke exposed in open air for some time, badly coked sample; 20 grms., 2 hours under Sprengel pump, gave 91·7 c.c. gas, containing—

Carbonic Acid.	Carbonic Oxide.	Hydrogen.	Marsh Gas.	Nitrogen.
39·020	7·673	53·317	trace	0·000

Analysis of Coke.

Ash.	Sulphur.	Loss at Red Heat.	Loss under Sprengel Pump.	Carbon by diff.
14·000	1·370	4·820	1·000	78·810

The author thinks it premature to hazard any suggestions as to the effect of the gases shown to be contained in coke when used in the blast-furnace. It is, however, probable that they are only eliminated at a very high heat, and most probably the carbonic acid is retained up to the fusing-point of cast-iron. He has, however, invariably found that what is termed weak coke, *i.e.*, a coke of which a greater quantity than usual is required to smelt a given quantity of ore, always contains the largest proportion of

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* Another chemist of considerable experience also gave 77 coke, unknown to the writer and before he had commenced these experiments.

hydrogen, and that nitrogen is absent, or present only in small quantity.

The author is now engaged in testing for occluded gas the ores and flux used in the blast furnace, with a view of quantitatively determining the volumes of gas as compared to the volumes of material used, first subjecting the samples to a full red heat until they have ceased to lose weight.

It is well known that both ores and flux are never entirely freed from volatile matter by ordinary calcination; but the amount of gaseous matter contained has not, as far as the writer is aware, been determined, and it is hoped that some benefit will be derived by the series of experiments now in progress.

It has been found in most instances that gas is given off by treatment under the Sprengel pump both from the flux and ores; and that argillaceous carbonates of iron contain carbonic acid, even after heating to semi-fusion. That samples roasted until they cease to lose weight, when tested under the Sprengel pump, evolve about three times their own bulk of carbonic acid; and that white cast-iron contains twice its own bulk of occluded gas, of which from 80 to 90 per cent is hydrogen.

NOTE ON THE DOCIMASTIC ASSAYING OF BISMUTH ORES,

AND ON THE DOCIMASTIC SEPARATION OF BISMUTH FROM COPPER, FROM ARSENIC, FROM ANTIMONY, AND FROM LEAD.

By HUGO TAMM.

(Concluded from p. 87.)

Docimastic Separation of Bismuth from Arsenic.

The separation of bismuth from arsenic is founded on the almost absolute want of affinity of bismuth for iron, on the readiness with which arsenic combines with iron, and on the fact that the arseniuret of iron thus formed does not alloy with bismuth. This operation, which is extremely elegant, is conducted in the following manner:—

Bismuth is melted at a relatively high temperature, at a bright red heat, under cover of borax or flux, to avoid loss of bismuth by volatilisation, and strips of iron are plunged in the molten metal. Iron is, according to the technical expression, rapidly "eaten away," forming arseniuret of iron, which rises on the surface of the metal.

When it is ascertained that fresh pieces of iron are no longer attacked, the whole is allowed to cool. The arseniuret of iron sets rapidly, and the bismuth, which is still fluid, is poured out of the crucible into moulds. Singularly enough, this process which succeeds in perfection for the separation of arsenic, is valueless when applied to the separation of bismuth from antimony; although, be it noticed, the affinity of this metal for iron is very great. Some antimony is removed by this process, but part of it only, and, it must be admitted, that bismuth has as much, or more, affinity for antimony than iron.

An analogous instance of these very remarkable *fire affinities* is evinced by alloys of lead and antimony, from which iron fails to remove antimony.

Although iron has no affinity for lead, the respective affinities of those two metals for antimony are so nearly equal that a perfect triple alloy of lead, antimony, and iron, is obtained.

Docimastic Separation of Bismuth from Antimony.

This problem, which was far from being as simple as it looked, was solved, like the other problems contained in these pages, by Newton's universal process of "thinking constantly about it."

The best way of separating the two metals is to melt the alloy with a quantity of oxide of bismuth, equal to two and a half or three times the weight of the antimony contained in the alloy. The oxide of bismuth is instantaneously reduced to the metallic state, and antimony is liberated under the form of oxide of antimony, which combines with a little oxide of bismuth, and floats on the surface of the pure metal, whence it can easily be removed.

This operation, which is of the simplest description, and is also very elegant, must be performed in clay crucibles, and both carbon and iron must be carefully excluded to avoid any reduction of oxide of antimony. The least traces of antimony may be removed by this process without any difficulty whatever. It may be as well to state here, that an analogous operation answers admirably well for the purification of lead containing antimony. Litharge acts on alloys of lead and antimony, exactly as oxide of bismuth on alloys of bismuth and antimony; the last traces of antimony may be removed by litharge.

Docimastic Separation of Bismuth from Copper.

As I have stated before, when bismuth ores contain only a small percentage of copper, and when the ores are oxidated ores, it is advantageous to reduce them at once by carbon and fluxes, without going through the sulphurising process: and, as a matter of course, all the copper is alloyed with the bismuth.

On the other hand, bismuth extracted from copper ores by the sulphur process contains, even in the best conducted operation, a certain proportion of copper which must be removed. This elimination presented very great difficulties, and could not be effected without losing a large amount of bismuth, until I devised the following method, which is perfect in every respect. Chemically, this method is a modification of the sulphurising process already described; but, practically, it has the advantage of effecting, as thoroughly as possible, a separation which was only approximately obtained by the sulphur process. It is by melting the alloy with sulphocyanide of potassium that I have succeeded in solving this difficult question.

The sulphocyanide which I use is prepared during the process of refining, by mixing together eight parts of cyanide of potassium and three parts of flowers of sulphur. One part of this mixture is thrown over sixteen parts of the metal melted at a low temperature.

A reaction soon takes place, by which the mass of the metal is brought to a bright red heat, and, at the same time, the sulphocyanide begins to burn vividly, throwing, in every direction, showers of scintillating sparks emitting a blue light.

The crucible is covered over, and great care must be taken to prevent the heat from rising above the burning point of the sulphocyanide, a temperature at which sulphuret of bismuth begins to volatilise.

The reaction is allowed to exhaust itself, and, when all is quiet, and after the metal has been well stirred with a clay stirrer (iron must be avoided), the flux is allowed to set, and the metal, which is still fluid, is poured out into moulds.

It is, I believe, the first time that sulphocyanides have been employed, or at least employed with so much success, as docimastic reagents. If those compounds which, as I have pointed out, may be formed by the direct action of sulphur on cyanide of potassium, were more abundant and cheaper, an important revolution, fertile in new applications, might be effected in that most conservative branch of industry—metallurgy.

Manufacturers of cyanides ought really to direct all their attention towards obtaining these compounds by some simple process, and endeavour to supply them at low prices; they would then constitute the most important docimastic and metallurgical reagents imaginable.

The great aim of modern metallurgy ought to be, the production of pure metals. With pure metals numberless alloys difficult or impossible to prepare, or useless, could be manufactured with facility and used with advantage; and the difficulties met with in the preparation of alloys with metals of unknown composition would be removed, and with them the secrets and obscure receipts used up to the present day in most manufactories.

It is impossible to lay too much stress on the important question of the preparation of pure metals, but, at the same time, it must be owned that, in many instances, this object cannot be accomplished without the introduction of new reagents and new reactions.

Separation of Bismuth from Sulphur.

The metal obtained in the above operation contains some sulphur. To remove this substance, the metal is melted with iron or carbon; the separation is thus effected as easily as possible.

Docimastic Separation of Bismuth from Lead.

It is with the deepest regret that I have to confess the utter failure of every means, whether simple or complicated, which I have brought to bear on this the most difficult problem of the metallurgy of bismuth.

Lead, it is true, may be removed partially, or even in totality, from its alloy with bismuth, but this removal of lead can only be effected, so to speak, by mechanical means, and it is consequently attended with an enormous loss of bismuth. The true cause of the failure of chemical means lies in the fact that the respective affinities of lead and bismuth are reversed by fire, and that bismuth substitutes itself to lead in the compounds of this metal and precipitates it from them.

I do not pretend to say that this problem is insoluble, but I simply wish to state that, up to the present day, it has not been solved, and that its solution is worth the exertions of docimasts.

Remarks.

The several processes which I have proposed are chiefly useful for the refining of bismuth alloyed with one metal.

There is no docimastic method of refining by one process bismuth alloyed with several metals; but the successive use of the different methods which I have described can safely be recommended.

Copper should be removed first, for the reason that some lead, antimony, and arsenic are eliminated at the same time.

Bismuth should next be freed from antimony, and, lastly, from arsenic and sulphur.

I have described as briefly as possible new processes founded on new reactions, in the hope that they will bear directly on the docimastic assaying and on the metallurgy of bismuth.

The whole looks very simple on paper, but, like simple things, it represents a vast amount of labour. The results obtained do not, perhaps, bear directly on science itself, and belong rather more to technology, but they rest on solid ground. They are independent of the revolutions which the human mind delights in effecting in its own theories, and, I might say, in the words of one of the most eminent analysts of this century, of Balzac, that they are derived from "Ceste bonne philosophie à laquelle besoing sera de tousjours revenir;" meaning, undoubtedly, the direct study of nature.

ON THE

BOILING-POINTS OF THE NORMAL PARAFFINS AND SOME OF THEIR DERIVATIVES.*

By C. SCHORLEMMER, F.R.S.

It is generally asserted that the boiling-points of the members of homologous series increase regularly for each increase of CH_2. Thus it is stated that in the series of the alcohols and fatty acids the boiling-point is raised 19° for each addition of CH_2, whilst in other series this difference is sometimes smaller, sometimes larger, but always the same in the same series. But in many cases the boiling-points calculated by this rule do not agree at all with those which have been observed. One reason for this discrepancy is that the compounds of which the boiling-points have been compared are not true homologous bodies, *i.e.*, that they have not an analogous constitution, although they differ in the composition by CH_2 or a multiple thereof. During the last year, however, we have become acquainted with some true homologous series, *viz.*, the series of the normal paraffins, and the normal alcohols and their derivatives.

In a paper read before the Royal Society I have already pointed out that the difference between the boiling-points of the lower members of these paraffins is not the same, but that it decreases regularly by 4° until it becomes the well known difference of 19°, as the following table will show:—

	Boiling-points.		
	Found (mean).	Calculated.	Difference.
$C\ H_4$	—	—	
C_2H_6	—	—	
C_3H_8	—	—	
C_4H_{10}	1°	1°	
C_5H_{12}	38	38	37°
C_6H_{14}	70	71	33
C_7H_{16}	99	100	29
C_8H_{18}	124	125	25
$C_{12}H_{26}$	202	201	4 × 19
$C_{16}H_{34}$	278	278	4 × 19

It appeared to me of interest to compare the boiling-points of other normal compounds, selecting of course those only of which the boiling-points have been carefully determined and corrected for pressure and expansion of the mercurial column of the thermometer above the vapour. The result of this investigation is that in most of the other series the difference between the boiling-points also steadily decreases by about 2°; but I am not in a position to state whether this decrease ceases when the difference becomes 19°, as we do not yet know a sufficient number of compounds.

I. *Normal Iodides.*

	Boiling-points.		
	Observed.	Calculated.	Difference.
Methyl, $C\ H_3\ I$	40·0°	40°	
Ethyl, $C_2H_5\ I$	72·0	72	32°
Propyl, $C_3H_7\ I$	102·0	102	30
Butyl, $C_4H_9\ I$	129·6	130	28
Pentyl, $C_5H_{11}I$	155·4	156	26
Hexyl, $C_6H_{15}I$	179·5	180	24
Heptyl, $C_7H_{13}I$	—	202	22
Octyl, $C_8H_{17}I$	221·0	222	20

Normal Bromides.

	Observed.	Calculated.	Difference.
Ethyl, $C_2H_5\ Br$	39·0°	39°	
Propyl, $C_3H_7\ Br$	71·0	71	32°
Butyl, $C_4H_9\ Br$	100·4	101	30
Pentyl, $C_5H_{11}Br$	128·7	129	28
Hexyl, $C_6H_{13}Br$	—	155	26
Heptyl, $C_7H_{15}Br$	—	179	24
Octyl, $C_8H_{17}Br$	199·0	201	22

Normal Chlorides.

	Observed.	Calculated.	Difference.
Ethyl, $C_2H_5\ Cl$	12·5°	13°	
Propyl, $C_3H_7\ Cl$	46·4	46	33°
Butyl, $C_4H_9\ Cl$	77·6	77	31
Pentyl, $C_5H_{11}Cl$	105·6	106	29
Hexyl, $C_6H_{13}Cl$	—	133	27
Heptyl, $C_7H_{15}Cl$	—	158	25
Octyl, $C_8H_{17}Cl$	180·0	181	23

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* Read before the Manchester Literary and Philosophical Society, February 6, 1872.

Normal Acetates.

		Observed.	Calculated.	Difference.
Ethyl,	$C_4H_8O_2$	74·0°	74°	
Propyl,	$C_5H_{10}O_2$	102·0	101	27°
Butyl,	$C_6H_{12}O_2$	125·1	126	25
Pentyl,	$C_7H_{14}O_2$	148·4	149	23
Hexyl,	$C_8H_{16}O_2$	168·7	170	21
Heptyl,	$C_9H_{18}O_2$	—	189	19
Octyl,	$C_{10}H_{20}O_2$	207·0	208	19

Whilst in these series the difference between the boiling-points steadily diminishes, in the series of the normal alcohols the difference appears to remain the same, being about 19°.

Normal Alcohols.

		Observed.	Calculated.
Ethyl,	C_2H_6O	78·4°	78·4°
Propyl,	C_3H_8O	97·0	97·0
Butyl,	$C_4H_{10}O$	116·0	116·0
Pentyl,	$C_5H_{12}O$	137·0	135·0
Hexyl,	$C_6H_{14}O$	156·6	154·0
Heptyl,	$C_7H_{16}O$	—	173·0
Octyl,	$C_8H_{18}O$	192·0	192·0

In the series of the normal fatty acids the difference between the boiling-points of the lower members is also constant, being 22°, but afterwards it becomes less.

Normal Fatty Acids.

		Observed.	Calculated.	Difference.
Acetic,	$C_2H_4O_2$	118·0°	118°	
Propionic,	$C_3H_6O_2$	140·6	140	22°
Butyric,	$C_4H_8O_2$	163·2	162	22
Pentylic,	$C_5H_{10}O_2$	184·5	184	22
Hexylic,	$C_6H_{12}O_2$	204·5	206	22
Heptylic,	$C_7H_{14}O_2$	220·0		
Octylic,	$C_8H_{16}O_2$	233·0		
Nonylic,	$C_9H_{18}O_2$	254·0		

ON THE ACTION OF LOW TEMPERATURES ON SUPERSATURATED SOLUTIONS OF GLAUBER'S SALT.*

By CHARLES TOMLINSON, F.R.S.

When a solution of the ordinary ten-atom hydrate of sodic sulphate, saturated at about 93° F., its maximum point of solubility, is boiled and filtered into a clean flask, which, being closed, is left to cool to 40° and under, a modified or seven-atom hydrate is formed at the bottom of the solution; this increases in quantity as the temperature falls, and passes into solution as the temperature rises; and so far the observation is supposed to be complete.

But if a supersaturated solution of Glauber's salt be reduced from ordinary atmospheric temperatures to low ones by means of a freezing mixture of snow and salt, the results obtained are very remarkable.

A solution of 1 part of Glauber's salt in one of water was boiled and filtered into a two-ounce flask that had been previously filled with strong nitric acid and well rinsed with clean water. The solution was again boiled in this flask, into which a thermometer was passed, the stem being surrounded by several turns of lamp-cotton, which served to close the flask as soon as it was removed from the source of heat.

Next day the flask was put into a freezing mixture at about 15° F. The solution slowly sank to 19°, when there was an abundant deposit of crystals of a peculiar opaque white, not like the transparent octahedra that are thrown down when these solutions cool to 40° and under, but very much like the octahedral crystals formed during the cooling of a strong solution of sal-ammoniac. There were tufts of regular octahedra and fern-like crystalline forms. During their formation the thermometer rose to 26°. The flask was now transferred to water at 48°, when the opaque white crystals broke up into an amorphous woolly mass. As the temperature of the solution rose to 40°, then for the first time the usual transparent octahedra of the anhydrous salts fell down. Next day the flask was opened; crystallisation of the ordinary salt set in from the surface, and the temperature rose from 44° to 65°.

Thus one more hydrate is added to those already known as belonging to this remarkable salt. It doubtless contains less water than the seven-atom hydrate; but I know of no method of testing its hydration, since its existence depends upon the low temperature and shelter from the action of nuclei. In this way it resembles the various hydrates described in my paper in the *Transactions*.

The solution was next made twice as strong as before; that is, 2 parts of Glauber's salt were dissolved in 1 part of water, and after boiling and filtering and re-boiling as before, the flask was set aside to cool. When the thermometer marked 42°, the flask was put into the freezing mixture. At 38° a few transparent octahedra were thrown down, and the heat currents thereby liberated delayed the cooling. In fourteen minutes it reached 26°, and the transparent crystals at the bottom became opaque white. The thermometer was stationary during some minutes at 26°, when it began again to descend; but on agitating the flask in the freezing mixture, crystals of the opaque white salt were formed, and the temperature regained 26°, the solution above being bright and clear and still supersaturated. In a few minutes crystallisation set in from the surface, and the thermometer rose from 26° to 53°, the whole being now solid.

These opaque crystals resemble in texture newly formed white-lead, and at whatever temperature they may be formed below 26° their formation causes the thermometer to rise to 26°, and that, too, in solutions of 1 part, 2 parts, or 3 parts of salt to 1 of water. This opaque salt is sometimes amorphous, and then it covers the surface of the flask like thick whitewash. This effect occurs when the flask is much agitated in the freezing mixture.

The same flask (2 of salt to 1 of water) was re-boiled without any addition of water, so that the solution was really stronger than that indicated. At 40° there was a fall of transparent anhydrous crystals. The solution was now purposely cooled very slowly, so that in half an hour it descended only 3°, *viz.*, to 37°. There was now a considerable increase of the anhydrous salt, so as to cover the bottom of the flask and to rise a little way up the sides. The flask was tranferred to a freezing mixture at 10°; when at 33° the anhydrous salt became opaque, doubtless from the fixation of a portion of water less than that required for the formation of the seven-atom salt. At 24° opaque tufts and fern-like crystals were formed. At 22° there was a sudden and copious deposit of this opaque white hydrate; thermometer rose to 26°, and then suddenly to 52°, when the whole mass was solid.

It is commonly supposed that the rise in temperature consequent on the solidification of a supersaturated solution is dependent on its mass; that when this is considerable the rise in temperature is so too, but that when the mass is small there is but little heating. This does not accord with my experience. Not much more than half an ounce of a comparatively weak solution of Glauber's salt, such as 1 of salt to 1 of water, may rise from 20° to 56° on suddenly becoming solid, and with 2 or 3 of salt to 1 of water the rise may not be greater, especially if a considerable mass of the two abnormal hydrates be already formed, and only a small portion of the solution remain to become solid.

In another experiment, 3 parts of salt to 1 of water

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* Abstract of a Paper read before the Royal Society.

were boiled and filtered into two test-tubes and one two-ounce flask. One tube, on being put into the freezing-mixture, sank to 35°, when the solution suddenly became solid and the thermometer rose to 78°. The other tube solution threw down so large a quantity of anhydrous crystals as to prevent the reading of the thermometer. The solution in the flask threw down anhydrous crystals at 44°, and then sank very slowly to 40°, where it remained stationary upwards of ten minutes, in consequence of the liberation of heat-currents, occasionally rising to 41°. A large quantity of transparent crystals was now heaped up on the bulb of the thermometer; the temperature descended to 38°, with slight starts upwards; and in slow descending to 33° there was a large increase of the transparent crystals. At 32° the flask was transferred to a fresh freezing mixture at 10°, and the solution slowly descended to 22°, when it was again removed to a fresh freezing mixture, also at 10°. Soon a number of large fern-like crystals covered the side of the flask, starting apparently from the top of the copious deposit first produced, and rendering the upper part opaque in a well-defined line. The temperature rose to 26°, and continued there some minutes, when the solution suddenly crystallised and the thermometer rose to 48°.

Supersaturated solutions of potash alum, exposed to low temperatures, behave much in the same way as the solutions of double salts described in my former paper. 300 grs. of the salt in 1½ ozs. of water, boiled and filtered into clean test-tubes, and, when cold, put into a freezing mixture at about 0° F., displays the beautiful ivy-leaf kind of foliage, of a brilliant white colour, already referred to. The growth starts from the bottom, or from the surface of the solution, or from both, and soon the whole solution becomes solid. If the tube be put into water at 32°, the solid rapidly melts, and the liquid is a clean bright supersaturated solution as before.

Löwel, in his first memoir (*Ann. de Chim. et de Phys.*, 3 série, tome xxix.), found that when supersaturated solutions of Glauber's salt, in sealed tubes, were subjected to temperatures varying from 3° or to 4° C., they often froze and burst the tubes. In one case, where the tube did not burst, the solution, in thawing, caused the state of supersaturation to cease. In another case, the frozen solution thawed, and the liquor became supersaturated as before. Löwel could not reproduce this last effect, nor explain why the thawing should lead to the formation of the ten-atom salt. But as he did not know the conditions of clean and unclean, he was constantly looking out for some catalytic action of the sides of his vessels to explain the many anomalous cases that occurred to him consequent on the use of vessels not chemically clean.

Among the numerous writers on the subject of supersaturation, I know of none that have noticed the formation of the second modified hydrate of sodic sulphate except M. Viollette, who, in a "Mémoire sur la Sursaturation" contained in the *Annales Scientifiques de l'Ecole Normale Supérieure* (Tome Troiséiem-Année, 1866), refers, p. 223, to the formation of another hydrate, "qui cristallise difficilement en forme de choux-fleurs."

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

XII.

Healthy human urine is an amber-coloured fluid, containing in solution various definite chemical bodies and also matter of an indefinite character known as extractives; it has a sp. gr. of from 1·005 to 1·025, a disagreeable bitter taste, a well-marked acid reaction, and a peculiar sweet odour said to resemble violets (?).

The variation in the sp. gr. is due to the fluid being so complicated and so readily influenced by the amount of fluid ingested; in disease this may be even more marked than above, as in hysteria being hardly above the standard, and in diabetes far exceeding the highest normal gravity; when, however, the sp. gr. is as high as 1·030, it should always give rise to a suspicion of wrong.

A very accurate and durable urineometer, invented by Mr. Blaise, may be used for its determination with almost as much precision as the sp. gr. bottle.

The chief constituents of urine are urea, uric and hippuric acids, kryptophanic acid (?), ammoniacal salts, phosphates, &c. Urea, CH_4N_2O, is the chief constituent of urine, and, as far as we at present know, carries off the greater part of the waste nitrogen from the tissues; its proportion is relative to the amount of nitrogenous food ingested; possibly exercise may influence it.

A ready method of noting whether it be in excess in the urine is to add a few drops of HNO_3 to a similar quantity of urine on a slip of glass, and watching the effect under the microscope; if in excess, crystals separate out. By evaporating urine to one-fourth its bulk, and adding HNO_3, a solid mass of nitrate of urea may be obtained.

The method now used for estimating the quantity of urea was invented by Liebig. Nitrate of mercury is made to precipitate the urea, the amount of mercury salt used giving the amount of urea present. It may be as well to mention here that Dr. Thudichum, in his research on urine, discovered a body which he named kryptophanic acid; to this, he says, is due the acidity of the urine. One of its properties is to combine with nitrate of mercury, and form a substance similar to the urea salt; admitting this, it follows that all urea estimations hitherto made have been fallacious. That Dr. Thudichum has seen some reasons for altering his opinion of the constitution of this body is true, but there can be no doubt that a hitherto undetermined body does exist in normal urine.

The normal percentage of urea in urine is from 1½ to 3 per cent.

Uric acid is present in small quantities in healthy urine, but in considerable proportion in that of gouty patients. It forms nearly the whole of the excrement of reptiles, and the greater part of birds.

It forms stones of considerable size in the bladders of persons suffering from this disease, and is frequently an hereditary taint; it is often seen in the urine of children as the "cayenne pepper grains."

Urine evaporated to one-fourth its bulk and treated with HCl yields this acid; it may be recognised by the murexide test.

In the above experiment, hippuric acid may also be thrown down, and may be known by its odour of benzoic acid when burnt.

Benzoic acid, administered internally, is converted into hippuric acid, whilst hippuric acid in the horses' urine is converted into benzoic acid if the animal is not at rest.

The colouring matter of the urine is a complex body, and probably directly derived from the hæmatin of the blood; the urine is always deeper in tint during febrile disturbance. Thudichum obtains several derivatives from it, as omicholine, uropittine, and uromelanine.

The subject has been one of interest to chemists for years, but very little useful matter has been brought forward, and it yet remains for a principle and its ready application to be discovered.

The salts in the urine are obtained by incineration, and are estimated in the usual way.

The kidneys appear to be the main drains to the circulatory system, for most matters of a soluble nature find their way into the urine; thus iodide of potassium is thrown off in less than twenty minutes after being taken, and if the hands be rubbed with iodine paint, in a few minutes iodine may be detected in the urine.

This is true, also, of many other things. Turpentine, rubbed on the skin, causes the urine to assume a very pleasant odour; and santonine, taken internally, so affects it as to cause it to stain all linen it may come in contact with.

ON THE MANUFACTURE AND REFINING OF SUGAR.*

By C. HAUGHTON GILL.

(Continued from p. 80).

Lecture IV.

I now come to the last branch of my subject. Having treated of the preparation of the raw material from its two main sources, viz., the sugar-cane and the sugar-beet, I have now to describe, but in outline only, one of the processes employed in the refining of that sugar, so as to render it fit for consumption. Many of these samples of raw sugar that I have laid before you are really quite uneatable; indeed, I was told this evening that one sample I had left here had been used for making a pudding, which had to be thrown away. It was a specimen of low, raw West Indian sugar, containing some 2 or 3 per cent of sand, and naturally, therefore, the pudding made with it was somewhat gritty.

The sugar refiner has to deal with this raw sugar, and his business is simply to cleanse it—in fact, the sugar refiner has to take dirty sugar and make it clean. And I propose this evening to tell you one process by which he does it, for there are variations in the methods employed, and perhaps no two sugar refiners work in precisely the same manner. I can only, therefore, tell you an outline of what takes place in one set of refineries, and I propose to choose those which turn out their main product in the form of loaves, such as I have placed on the table.

In the first place, I must tell you that the sugar which the refiner has to deal with is, of course, of two sorts, cane sugar and beet sugar, as the case may be, but it makes no difference to him which he employs. Refined sugar, from whatever source it is made, has identically the same properties, and, in fact, cannot be distinguished by any means I am acquainted with. Before entering on the details of the work performed in a refinery, I must mention again what I have previously implied with regard to the nature of raw sugar. In both cases, if you recollect, the more or less purified juice of the cane or the beet respectively has been evaporated with greater or less precaution, to avoid the destructive action of heat and acids, until the solution became a hot saturated solution, and that then the sugar has been caused to crystallise in one way or another. In any case, the sugar crystallised in the concentrated solution somewhat quickly, and, as you saw by the samples I produced, the crystals were small and confused. Now consider the conditions under which they have been formed. They have grown in a solution which contained not only sugar and water, but also a good many impurities, including saline combinations and albuminous bodies, and, at any rate, in the case of cane sugar, very often a considerable amount of actual solid impurities, feculencies of one fluid or another, the *débris* of plant-cells which had remained in the liquid, never having been separated from it, and which, therefore, remain ultimately hanging to the small crystals of sugar formed in the syrup, which consists of sugar, water, and various gummy and other bodies, of which the nature is practically not known.

The syrup surrounding these crystals is of a very sticky nature, and when the mass, consisting of grain sugar and syrup, is allowed to drain slowly by itself, or when it is put into a centrifugal machine, such as I showed you last week, still the syrup is not perfectly separated from the grains of sugar. Each individual grain of sugar remains wet with the syrup, which syrup is obviously not a pure solution of sugar, and, therefore, the material which is won in this way is not pure sugar. Even if the crystals themselves were quite pure, their remaining wetted with a solution which is not that of pure sugar causes the material itself to be contaminated with various foreign bodies, which it is the refiner's duty to remove.

Now, the impurities adhering to the crystals of sugar are of two kinds—solid ones, which, if washed and dried, would be described in ordinary language as mere fluffiness; and also soluble bodies, which were not removed in the processes to which the juice was subjected. The refiner gets the sugar containing these impurities, and his first operation is to dissolve that sugar in water. This generally performed in large circular cast-iron pans, containing 4 or 5 tons of sugar, with a proportion of water sufficient to dissolve it, which is about half the weight of the sugar. I have so dissolved a quantity of raw sugar here, and it is by no means a bad specimen; still you see the solution is quite cloudy, indicating that there are solid bodies present which interfere with the free transmission of the rays of light. If the solution were simply coloured, but were free from solid bodies, it might look dark in colour, but still it would be transparent and bright. The refiner, then, has first to get rid of this solid matter, and the obvious plan is to pass it through a filter in the same way as I clarified a solution the other day, by passing it through a folded filter-paper. But all these fluffinesses tend very rapidly to choke up the pores on any filter on which you can pour the solution, and accordingly it becomes very difficult to clarify the liquid simply by filtering. The difficulty is very often got over by a method which you have all heard of, and I dare say thought very nasty, I mean by the use of blood. Blood consists of two parts. When it is first drawn from the animal, if it is allowed to stand quietly by itself, it soon sets into a sort of clot; that arises from the passing of one constituent of the blood into a solid form; the fibrin, as it is called, becomes solid, and binds the whole mass into a clot—that is, if the blood is allowed to stand still. If fresh-drawn blood be stirred, the fibrin collects in a sort of thread, whence its name, and this can be all withdrawn from the mass, leaving behind a solution, somewhat coloured, of the other constituents of the blood, among which albumen, that is, the same body as the white of egg, is the most important. I am going to show you the effect of putting this defibrinated blood into a solution of sugar. I might have used white of egg in the same way, but blood being more generally used (except in Russia), I thought I had better use it on this occasion, when you will see its effect in clarifying the solution. The solution ought to be at a temperature of about 120° or 140°. You can anticipate what will occur if we mix a solution containing solid particles either with white of egg stirred up with water or with this albuminous portion of the blood, and then heat the liquid to near the boiling-point. You know that white of egg sets when it is heated. If I mix, therefore, albumen of the blood with this solution of sugar, and then heat it up to the point at which the albumen will coagulate, there will be a sort of network of solid albumen formed, and that will entangle every particle of foreign matter in the solution, and, at the same time, there will be bubbles of air enclosed in it, and the mass will float up to the surface, forming a sort of scum. As it comes to the top it will carry with it the solid impurities contained in the sugar. I am now using a larger quantity than is used practically in sugar refining, for only two or three buckets full are used for several tons weight of sugar. After heating the solution to the temperature at which the albumen will coagulate, I will strain off the liquid, and I think we shall find that it will be, though still coloured, clear and transparent. When this has been performed in the "blow up" pans, as they are called, and the liquid has been blown up and clarified in this way, the scum has to be separated from the liquid. This

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* The Cantor Lectures, delivered before the Society of Arts.

cannot be done on a large scale by allowing the mass to stand, and straining the liquid off through a pipe, but another and more perfect mode has to be adopted. That is done by pressing the whole contents of these "blow up" pans through a series of bags made of twilled cotton cloth, each of which is placed inside another case of very coarse hemp material, which simply serves to hold the bag together, and being much smaller than the inside bag, causes the surface of the latter to lie in folds, which present a large filtering surface. On the table there is a specimen of one of these bags with its case; one end is attached to a pipe, through which the liquid runs down and fills the bag below, and passing through the folds of the bag, it runs out clear, leaving all solid matter behind. The liquid that passes through these bags is, of course, highly coloured, if it is a solution of anything like ordinary raw sugar. There is a specimen on the table of the result.

The liquid now passes into a series of iron cisterns, where it remains until it is wanted. When almost boiling hot, it is run into the top of an iron cistern, like a large steam boiler turned on end—a vessel made of cast-iron, perhaps 20 feet high by 7 in diameter, and capable of holding from 15 to 20 tons of animal charcoal. The liquor runs into the top of this cistern, which is nearly filled with animal charcoal, and gradually percolates downwards through it.

Now, I have shown you already one action of animal charcoal. You recollect that when a solution of dextrine passes through a column of animal charcoal it loses its dextrine, and the solution of sugar in passing through the animal charcoal loses in like manner portions of the albuminous and gummy matters contained in it. But now I wish to show you another action which is very remarkable, and far more striking at first sight than the one I have mentioned. I refer to the power which animal charcoal has of absorbing from a solution many vegetable colouring matters. For the purpose of exhibiting this power, I will choose a solution of indigo, and show you its effect. The sugar, in passing through this column of animal charcoal, loses, in great part, the colouring matters which it originally had, and, at the same time, as I told you, some of the less visible but somewhat more important bodies of a gummy nature. Here are two solutions, one before going through animal charcoal, and one after, and you see the difference, through I have taken a not very favourabe specimen, because the liquor had been running through for some time, and, therefore, the decolourising power of the charcoal had become to some extent exhausted. It is a very important matter to the refiner to get the solution of a good colour, and therefore great care is taken in this process. Now, to show you the effect of the charcoal on the solution of indigo:—I might have chosen caramel, which is, practically, burnt sugar, or many other colouring matters, such as cochineal, and it would have shown the same result. On putting into this solution of indigo some powdered animal charcoal, and boiling the two together for some minutes, and then filtering the liquid, you see that the charcoal has removed the colouring matter to a very considerable extent; and the same effect is produced on the sugar liquid on passing it through these large charcoal filters.

From these charcoal filters, the liquor, which is now almost colourless, passes to a vacuum pan, the mode of action of which I have already described. The solution is concentrated there until it becomes a supersaturated solution. It is then caused to crystallise, and the crystals are made to grow in size by the admission of fresh portions of the liquor into the pan from time to time, and the evaporation of the water belonging to that liquor, until the pan is nearly filled with a mixture of grains of sugar floating in a hot saturated solution of sugar, *plus* the impurities which still remain. When the "boiler" judges that the mass in the pan is of sufficient strength, he stops the process of evaporation by simply shutting the valve which communicates with the air-pump, and causes the boiling to cease. He then allows the temperature of the mass to rise some 20 or 30 degrees. Now, what is the effect of raising the temperature? As I have stated, and shown to you by experiments, water has a point of saturation for every soluble solid at each degree of temperature, and, as a rule—at any rate it is the case with sugar—the higher the temperature, the more of the solid matter will dissolve. Now, we had here a mass of crystals floating in a syrup, saturated at a temperature, say, 150° F. Now, on raising the temperature of this mass, the water present in the syrup becomes capable of dissolving an increased proportion of sugar, and accordingly some small portion of these grains, or small crystals, passes again into solution; the syrup becomes more concentrated at the same time that it becomes hotter. This heated magma of crystals and syrup is now filled out as rapidly as may be into a series of moulds, which vary in size in different refineries. I have here a specimen of one of the smaller size, the shape of which will be familiar to you; they have an opening at the bottom, which can be readily closed or opened. In these moulds the mass is allowed to stand for a couple of days or so; first it stands for twenty-four hours, when it becomes entirely set into a hard cake. How is it caused to set?

(To be continued).

MISCELLANEOUS.

Royal Dublin Society.—Dr. Emerson Reynolds read a paper on Monday evening, the 19th ult., "On Coal-Gas and its Flame." The lecturer referred to Sir H. Davy's theory of the luminosity of flame, and Professor Frankland's later theories. The lecturer was of opinion that more reliance should be placed upon the latter. The lecture was illustrated by numerous experiments.

Royal Geological Society of Ireland.—The Annual Meeting of this Society was held on Wednesday, the 14th ult., in the Museum Buildings, Trinity College. Dr. Alexander Macalister was elected President, in room of the Earl of Enniskillen, who had resigned. After the election of the Council and other routine business, Mr. Edward Hull, F.R.S., read a paper "On a Remarkable Fault in the New Red Sandstone of Rainhill, Lancashire."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition o the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, February 5, 1872.

In addition to several important memoirs and papers relating to mathematical, mechanical, astronomical, and other sciences, and a very exhaustive report on aërial navigation, this number contains the following original papers and memoirs relating to chemistry:—

Researches on Fermentation.—E. Fremy.—The second instalment of this lengthy monograph, the contents of which are, notwithstanding its very high intrinsic merits, not suited for useful abstraction.

Laws Governing the Motion of the Flow of Liquids in Capillary Space (Espace Capiliaire).—E. Duclaux.—An algebraico-physical paper.

Chemical Studies on the Landes of Brittany.—A. Bobierre.—The contents of this paper, although mainly of local interest, throw some light on the causes of the sterility of the soils here termed *landes*, that is to say, barren sandy moorlands bearing only imperfect plants of a stunted growth, heather and the like. It appears that the cultivation of fir-trees, *Pinus maritima*, and other species is beneficial for bringing such soils into a different mechanical as well as chemical condition, and thereby afterwards suited for tillage.

Contraction which Solutions of Cane Sugar Undergo at the Moment of Inversion, and on a New Saccharometrical Process.—Dr. G. Chancel.—Reserved for full translation.

Analysis of Linseed Oil.—Dr. Sacc.—By saponification with oxide of lead, 100 parts of oil gave 6 of glycerine and 102 of fatty acids, 94 per cent thereof being oleic acid, and the remaining 8 margaric acid. The author evidently has not taken any notice of the very minute and exhaustive researches on drying oils made some twelve years ago by Dr. G. J. Mulder, who published a monograph on this subject. The main constituent of linseed and other so-called drying oils is linoleine, $3(C_{32}H_{27}O_5),C_6H_5O_3$ (see Chemical News, vol. xxiv., p. 299).

This number contains two papers by different authors on the spectrum of the aurora borealis observed on February 4 last.

Journal für Praktische Chemie, No. 20, 1871.

This number contains the following original papers and memoirs:—

On Nitroso-Diethyline.—A. Geuther.—This paper treats in the first place on the action of strong alkalies upon nitroso-diethyline, against which this substance is indifferent at temperatures below 155° when treated along with either aqueous or alcoholic potassa solution in a sealed tube; at the temperature alluded to, decomposition ensues, accompanied by the formation of ammonia, ethylamin, and nitrogen, while, the potassa having become simultaneously carbonated, the nitrosyl group was destroyed, and its oxygen employed for the oxidation of C_2H_5. The process may be elucidated by the following formula:—

$$4[(C_2H_5)_2.NO.N]+8KOH=$$
$$=4(C_2H_5.H_2N)+2NH_3+C_2H_4+2N+4CO_3K_2+3OH_2.$$

Next, the action of reducing agents, sulphuretted hydrogen, ammonium hydro-sulphide, ferrosulphate and bisulphite of soda, were tried as regards their action upon nitroso-diethyline; even up to a temperature of 150° these reagents do not act upon the body just mentioned, but sodium amalgam acts in the presence of water most energetically upon nitroso-diethyline, the result being the formation of diethylamine and protoxide of nitrogen, according to the following formula:—

$$2[(C_2H_5)_2.NO.N]+4H=(C_2H_5)_2HN+N_2O+OH_2.$$

Dry hydrochloric acid gas acting upon nitroso-diethyline converts it into diethyl-ammonium chloride and probably nitrosyl chloride, according to the following formula;—

$$(C_2H_5)_2.NO.N+2HCl=(C_2H_5)_2H_2NCl+NOCl.$$

Composition of Hydrate of Antimonic Acid.—A. Geuther.—The results of the author's researches are—(1). That the thoroughly air-dry hydrate is neither per-hydroxy nor mono-hydroxy acid, but trihydroxy-antimonic acid. (2). When this acid is heated to 175°, there is driven off as much water as will leave a mono-hydroxy acid, which (3) when heated to 275° yields antimonic-acid-anhydride, which, again, when heated to 300° yields, while oxygen is given off, antimonious-antimonic-acid-anhydride.

Decomposition of Chloride of Phosphorus by Water.—A. Geuther.—After briefly referring to Dr. Kraut's researches on this subject, published in the *Ann. d. Chem. u. Pharm.*, clviii., p. 333, the author records the results of a series of experiments, from which it appears that Dr. Kraut's statement, that, by the contact of chloride of phosphorus and boiling water, amorphous phosphorus is separated, is not correct, but otherwise the results of the experiments of Dr. Kraut are fully confirmed.

Action of Sodium Alcoholate upon Benzoic-Acid-Ether.—A. Geuther.—Sodium alcoholate free from alcohol, when heated along with benzoic-acid-ether to 160° for a considerable time, yields chiefly sodium benzoate and ordinary ether, according to the formula—

$$C_7H_5(C_2H_5)O_2+C_2H_5NaO=C_7H_5NaO_2+(C_2H_5)_2O;$$

but, at the same time, there are three by-products formed, which, according to the researches published in this paper, are formic acid, a liquid boiling at 200° ($C_{26}H_{34}O_3$), and another liquid boiling at 360° ($C_{37}H_{36}O$); these fluids are neutral oily substances.

Action of Phosphoric Chloride upon Anhydrides and Chlorides.—Dr. A. Michaelis.—This essay is divided into the following sections:—Phosphoric chloride and sulphurous anhydride; phosphoric chloride and sulphuryl-hydroxyl chloride; phosphoric chloride and pyro-sulphuryl chloride, chromacichloride, potassium bichromate, antimonious-acid-anhydride, antimonic-acid-anhydride, oxide of bismuth, oxide of lead, peroxide of lead, oxide of tin, oxide of copper, oxide of mercury, molybdic acid, and tungstic acid.

Chemical Retrospect of the Year 1871.—Dr. Kolbe.—The eminent *savant* shows in this paper that he is not only thoroughly well acquainted with science, but also with the conditions existing in different countries; his allusion to the United Kingdom, while courteous and complimentary towards its men of science, contains a very true and correct view of the disdainful contempt with which science in general, and chemistry especially, is treated in certain quarters.

Polytechnisches Journal von Dr. E. M. Dingler, first number for January, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Chemistry of the Devitrification of Glass.—Dr. H. E. Benrath.—After first briefly referring to the observations of Réaumur (150 years ago), and to the later researches made on the devitrification of glass by Dumas, Pelouze, Terreil, and others, the author (a practical glass manufacturer) gives a detailed account of his experiments and analysis of different kinds of glass before and after the devitrification. The author concludes this very exhaustive essay by stating that, in his opinion, the behaviour of glass before and after devitrification is, that the silica in glass is not so much in the condition of three- or four-fold combination as in that of solution in glass (perhaps $RO,2SiO_2$), and then, as is the analogous case with all solutions to different temperatures, correspond different maxima of dissolved substance.

Generation of Electricity in the Electric Chain (Kette), and its Relation to the Chemical Process.—H. Rheineck.—The first instalment of a very lengthy essay on this subject. The contents are, however, notwithstanding their high scientific value, not suited for useful abstraction.

Researches on the Formation of Aniline Red.—Dr. Rosenstiehl.—The contents of this essay may be summarised thus: (1) pseudo-toluidine, heated by itself to 170° along with arsenic acid, is partly converted into pseudo-rosaniline; (2) this conversion takes place at the ordinary temperature when either pseudo-toluidine by itself, or its salts, are acted upon by the air; (3) it is this behaviour which causes the sensitive colour reaction of pseudo-toluidine, which reaction is not interfered with by the presence of either toluidine or aniline; (4) the formation of pseudo-rosaniline frequently occurs in the process of the generation of aniline black, and is in that case a great inconvenience; (5) by the dry distillation of indigo with an alkali, a mixture of aniline and pseudo-toluidine is obtained.

Action of Bone-Black in the Process of Sugar Refining.—E. Wernekinck.—The contents of this lengthy essay bear mainly upon practical matters relating to sugar refining.

Contrivance for Rapidly Determining the Quantity of Starch Contained in Potatoes.—Dr. A. Schwartzer.—This paper treats on a subject which is not much attended to in this country—to wit, the good quality of potatoes as ascertained by their specific gravity—it being a well-known fact that the more starch (the main constituent of this tuber) potatoes contain the higher their specific gravity. The author describes at length a contrivance (weighing machine of simple construction) with the aid of which samples of potatoes (quantities of at least 5 kilos. together) can be conveniently tested for their specific gravity.

A Mixture Suitable for Lucifer Matches, and not containing Phosphorus.—W. Jettel.—Percentically—Glass, 8·77; glue, 7·12; bichromate of potassa, 5·59; chlorate of potassa, 46·76; oxide of iron (brown umber, Fe_2O_3), 4·03; manganese, 13·07; sulphur, 7·41.

Prize Essay on Sugar Manufacture.—The East Bohemian Association of Sugar Manufacturers intends to give a sum of £50 for the best essay on sugar manufacture. This work must consist of two sections. The first section, chemico-technical, to contain—(*a*) Well-made and complete researches and analysis of all the raw materials used in the process of sugar manufacture; (*b*) complete analysis of all the products obtained in this manufacture; (*c*) a succinct and explanatory description of the chemico-technical operations required in the sugar manufacturing process; (*d*) a complete collection of all the tabulated forms required to assist the making of calculations for the various manipulations; (*e*) a brief, yet complete, description of the sugar manufacturing process, beginning with the washing of the beet-roots and ending with the refined produce. The second section, mechanico-technical, should treat, in full details, on the plant and machinery required, on the management of the operations, and on the means to be employed for keeping the plant and machinery in good repair. Competitors should send their essays to Herrn Fr. B. Goller, Manager of Sugar Works, at Podebrad, in Bohemia. The essays ought not to contain the names of the authors, which sbould be sent in a sealed note bearing on the envelope a motto, also to be placed on the fly-leaf of the essay. The jury to judge on these essays is to consist of a mixed scientifico-technical committee of six members.

Zeitschrift für Chemie von Beilstein, No. 16, 1871.

This number contains the following original papers and memoirs:—

Action of Alkaline Bisulphites upon some of the Diazo Compounds.—P. Römer.—By treating a concentrated aqueous solution of bisulphite of potassa with nitrate of diazo-benzol gradually added while in aqueous solution, the author obtained a crystalline compound which, after having been dried at 120°, was found on analysis to yield results leading to the formula $C_6H_7N_2SO_3K$, while the formation of this salt is elucidated by the following formulæ:—

$$C_6H_5N_2O_3:2HKSO_3:H_2O=C_6H_7N_2SO_3KH_2SO_4,KNO_3.$$

The author tried to obtain the free acid by treating the potassa salt here alluded to with hydrochloric acid, but he did not thus obtain well-defined crystals. By double decomposition, the baryta salt was prepared. When a solution of the potassa salt alluded to was added to a solution of nitrate of silver, metallic silver was instantaneously thrown down, while the liquid becomes yellow-coloured, and yields, by careful evaporation, a silver-salt which becomes blackened at 100°; the formula of this compound is $C_6H_6NSO_3Ag$. Diazo-benzol-sulpho acid, $C_6H_4N_2SO_3$, behaves with bisulphite of potassa in an analogous manner, yielding a potassa salt of a new acid, $C_6H_8N_2SO_3$, the formation of which is elucidated by the following formulæ :—

$$C_6H_4N_2SO_3 : 2HKSO_3 : 2H_2O = C_6H_8N_2SO_3 2KHSO_4.$$

The acid decomposes carbonates, is readily soluble in boiling water' and sparingly so in alcohol and cold water; the constitutional formula of this new acid is—

$$C_6H_4 \left\{ \begin{matrix} NH—NH_2 \\ SO_3H \end{matrix} \right.$$

Some of the Derivatives of Lepiden.—N. Zinin.—The first product of the oxidation of lepiden, $C_{28}H_{20}O$, is oxylepiden, $C_{28}H_{20}O_2$; when this compound is treated with a solution of chromic acid in glacial acetic acid, there is formed, by the aid of heat (70°) dioxylepiden, $C_{28}H_{20}O_3$, a solid crystalline body, fusing at 157°, soluble in boiling alcohol at 95 per cent (1 part of the substance requires 24 parts of alcohol), soluble in the same proportion in boiling glacial acetic acid. Chromic acid converts dioxylepiden into benzoic acid and benzyl; reducing agents have no action at all on dioxylepiden, while the oxylepiden is thereby again converted into lepiden. When treated with weak alcoholic solution of caustic potassa, dioxylepiden is converted into desoxybenzoin and benzoic acid—

$$C_{28}H_{20}O_3 + 2KHO = C_{14}H_{12}O + 2C_7H_5KO_2 ;$$

hence the rational formula of dioxylepiden is $C_{14}H_{10}(C_7H_5O)_2O$.

Oxidation of Tertiary Alcohols.—A. Boutlerow.—After first referring to his former treatise on this subject, the author now records at length another series of researches on the oxidation and mode of progress of oxidation of the tertiary alcohols. Dimethyl-ethyl-carbinol yields, by oxidation, acetic and carbonic acids; dimethyl-propyl-carbinol yields acetic and propionic acids; methyl-diethyl-carbinol yields acetic acid; triethyl-carbinol yields acetic and propionic acids; trimethyl-carbinol yields aceton, acetic, propionic, and iso-butyric acids; while dimethyl-pseudo-propyl-carbinol yields pseudo-propyl and aceton. The author further states that tertiary alcohols which contain the phenyl group will yield, by oxidation, benzoic acid, since in these the C-atom will be eliminated along with the most complex (also the most stable) alcohol radical.

Cinnamic Acid.—F. Beilstein and A. Kuhlberg.—This essay is divided into the following sections:—Purification of cinnamic acid; nitro-hydro-cinnamic acid; para-nitro-hydro-cinnamic acid; salts and ethers of this acid; nitro-cinnamic acid; para-nitro-cinnamic acid; salts and ethers of this acid; β-nitro-phenyl-chloro-lactic acid.

Action of Chlorine on Isopropyl Chloride.—C. Friedel and R. D. Silva.—Very pure isopropyl chloride was submitted to the action of chlorine, aided by direct sunlight, and the fluid next treated by fractional distillation, resulting in the yield of methyl-chlor-acetol and propylen chloride; the former predominates, while, as regards the latter, its quantity varied from two-thirds to one-fifth of that of the former.

Annalen der Chemie und Pharmacie, December, 1871.

This number contains the following original papers and memoirs:—

Valerianic Acids of Different Origin.—E. Erlenmeyer and C. Hell.—The contents of this very extensive memoir are not suited for abstraction; we quote the headings of the different sections—Introduction, containing a clear and concisely-written review of all the scientific researches on this subject; valerianic acid from isobutyl cyanide; valerianic acid from valerian root; valerianic acid from amylic alcohol; valerianic acid from optically-active amylic alcohol; valerianic acid from leucine; experiments made with the view of obtaining optically-active valerianic acid; behaviour of inactive and active valerianic acid by oxidation.

Water Contained in Wells Situated in Towns and Populous Places.—Dr. C. Aeby.—This essay on water analysis, to which are appended the results, exhibited in tabulated form, of a series of experiments chiefly made with water at Bern, is mainly of local interest only.

Animal Cellulose.—Dr. Schäfer.—The results of this very lengthy essay, containing the detailed account of a series of chemico-physiological researches, may be summarised as follows:—In the first place, animal cellulose exhibits a greater resistance to the action of chemical reagents, but otherwise agrees with vegetable cellulose in the following properties and reactions:—Percentage composition; becoming blue-coloured by iodine, after having been first treated with sulphuric acid; solubility in ammoniacal oxide of copper, from which it is again precipitated by acids (the precipitate thus obtained is, however, physically changed to a certain extent, viz., as far as is concerned solubility in dilute hydrochloric acid, and also becoming tinged with iodine); conversion into fermentable sugar by longer action of sulphuric acid; conversion into a nitro body by the action of very concentrated nitric acid, the resulting substance sharing the properties partly of collodion, partly of gun-cotton.

Occurrence of Chondrigenous Substance in the Tunicatæ (Class of Lower Animals, Molluscs).—Dr. Schäfer.—From the researches recorded in this paper we learn that in the tissues of this kind of animals a substance is met with which, in its properties and reactions, and also in the percentage of nitrogen it contains, corresponds very closely to chondrine.

Another Instance of the Occurrence of Inosite (a Kind of Sugar) in the Vegetable Kingdom, and Conversion of that Substance into Paralactic Acid.—Dr. Hilger.—After briefly referring to the discovery of inosite by Dr. Scherer in the muscular substance of the heart, and the extensive researches of a great many *savants* on this substance (also met with in certain plants), the author records at length his researches, by which he has been enabled to ascertain the presence of inosite in grape-juice, and, further, the conversion of this substance into paralactic acid under the influence of decaying cheese, while simultaneously propionic acid is formed. As a confirmative proof that the lactic acid obtained is paralactic acid, the author oxidised it with chromic acid, thereby obtaining malonic acid, the silver-salt of which, $C_3H_2Ag_2O_4$, was analysed.

Presence of Paralbumen in Serous Transudations.—Dr. Hilger.—By paralbumen, the author designates a modification of serum-albumen, the alcoholic precipitate of which is soluble in water, and only partially coagulated by the addition of small quantities of acetic acid; this paralbumen has been hitherto only found in the hydropical ovarian cysts, but the author has recently found it also in the fluid abnormally secreted in ascites.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 18, 1872.

Studies on the Iron Ores of some of the Metallurgical Districts in the Eastern Parts of France.—M. Letaud.—By the recent events France has lost all its iron industry in what were its eastern districts, and the contents of this paper treat really on the iron ores of the Grand Duchy of Luxemburg, where, as is well known, very extensive and valuable iron ore deposits are found. The author gives an excellent review of this subject, elucidated by a large number of results of analysis of ores, made by Drs. Kerkhoff and Reuter.

Eolipile, Vapour-Lamp, Constructed to Burn the Vapours of Petroleum Spirit and other similar Fluids for Laboratory Use.—Dr. Debray.—Illustrated by woodcuts. An excellent contrivance for use where gas cannot be had.

Application of Dynamite for Boring Artesian Wells.—Dr. Hamel.—The account of some successful experiments made in Denmark.

Bibliography.—Under this heading we notice—"De la Conservation de la Viande et autres Substances Alimentaires par le Froid et la Dessication," par M. Ch. Tellier; ouvrage nouveau contenant 108 gravures, 12 planches, et 3 cartes; chez l'Auteur, 99, Route de Versailles, Paris-Auteuil. From the very lengthy review here given, it appears that the contents of this work merit general attention not only in France but everywhere, since the subject of suitably preserving animal and other food is of the highest importance also in a commercial point of view. "La Ferme et les Champs," par M. E. Vianne; un fort volume, 550 pages et 375 gravures, prix 6 francs; A. Sagnier, Editeur, 7, Carre four de l'Odéon, Paris. An excellent and very well-written book on agriculture and what relates to it—implements, horses, cattle, &c.

La Revue Scientifique de la France et de l'Etranger, February 17, 1872.

This number does not contain any original papers on chemistry, but from a brief *resumé* of the proceedings of the meeting of the Chemical Society of Paris, held on the 2nd of February last, we note here that Drs. C. Girard, Lauth, and Jungfleisch, having repeated the experiments of Drs. Dusart and Bardy (Chemical News, vol. xxv., p. 81), find that even at 340° no such reaction ensues, even if the experiment is continued for fifteen hours; the different bodies named *loco citato* remain qualitatively and quantitatively as they were. When we receive the *Bulletin Mensuel de la Société Chimique de Paris* we shall give a more complete account of the proceedings.

MEETINGS FOR THE WEEK.

Monday, March 4th.—Medical, 8.
—— Royal Institution, 2. General Monthly Meeting.
—— Anthropological, 8.
—— London Institution, 4. Prof. Odling, F.R.S., "On Elementary Chemistry."
Tuesday, 5th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Zoological, 9.
Wednesday, 6th.—Society of Arts, 8.
—— Geological, 8.
—— Microscopical, 8.
—— Pharmaceutical, 8.
Thursday, 7th.—Royal, 8.30.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
—— Chemical. 8. Dr. Debus, F.R.S., "On the Reduction of Ethylic Oxalate by Sodium Amalgam." Alfred H. Allen, "On Metastannic Acid, and the Detection and Estimation of Tin."
—— Royal Society Club, 6.
—— London Institution, 7.30. Paper and Discussion.
Friday, 8th.—Royal Institution, 9. R. Liebreich, Esq., "On the Effect of certain Faults of Vision on Painting, with especial reference to Turner and Mulready."
—— Quekett Microscopical Club, 8.
—— Astronomical, 8.
Saturday, 9th.—Royal Institution, 3. Moncure D. Conway, "On Demonology."

NOTES AND QUERIES.

Butylen Glycol.—Will any one kindly give me the equations by which butylen glycol is a condensation of or from aldehyde, just as hydrobenzoin is from benzaldide. There are many very curious questions which might be asked of M. Schiff in regard to the special elongation of the coniine atom—we forbear! But how is it that when first discovered it appeared $(C_8H_7)_2H.N$ or $C_{16}H_{15},N$, whereas now, with a very different type of elongation, it is $C_{20}H_{19},N$.—S. E. P.

Pearl-Hardening—Selenite.—Can any of your readers give me the following information:—What the process consists of known as "Julien's patent" for making "pearl-hardening," and if the article is superior for any uses to the article made in Derbyshire from alabaster, and what the market price per ton is for the same (pearl-hardening). Would also like to know if pure crystallised selenite is to be found in England in any quantity, and if a market could be found there for this in any considerable quantity in the rock state?—Thomas Manning, Boston, Mass.

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THE CHEMICAL NEWS.

VOL. XXV. No. 641.

ON SOME DERIVATIVES OF URAMIDOBENZOIC ACID.[*]

By P. GRIESS, F.R.S.

THIS acid, of which I gave a short description some time ago[†], has the composition $C_8H_8N_2O_3$. I obtained it in the first instance from the basic compound $C_{10}H_{12}N_2O_3$, which is one of the products of the action of cyanogen of an alcoholic solution of amidobenzoic acid. Its formation takes place in the manner indicated in the following equation:—

$$\underbrace{C_{10}H_{12}N_2O_3}_{\text{Basic compound.}} + \underbrace{H_2O}_{\text{Water.}} = \underbrace{C_8H_8N_2O_3}_{\text{Uramidobenzoic acid.}} + \underbrace{C_2H_6O.}_{\text{Alcohol.}}$$

Since then I have shown[‡] that this acid is formed also when urea and amidobenzoic acid are cautiously melted together:—

$$\underbrace{C_7H_7NO_2}_{\text{Amidobenzoic acid.}} + \underbrace{COH_4N_2}_{\text{Urea.}} = \underbrace{C_8H_8N_2O_3}_{\text{Uramidobenzoic acid.}} + \underbrace{NH_3.}_{\text{Ammonia.}}$$

A third and more advantageous process of preparing uramidobenzoic acid, that of Menschutkin[‖], depends on the mutual decomposition which takes place when aqueous solutions of potassium cyanide and amidobenzoic acid hydrochlorate are mixed:—

$$\underbrace{C_7H_7NO_2HCl}_{\text{Amidobenzoic acid hydrochlorate.}} + \underbrace{CNOK}_{\text{Potassium cyanate.}} = \underbrace{C_8H_8N_2O_3}_{\text{Uramidobenzoic acid.}} + \underbrace{KaCl.}_{\text{Potassium chloride.}}$$

Menschutkin has described this acid under the name of oxybenzuramic acid, but I have satisfied myself that it is identical with the uramidobenzoic acid obtained by the two first-mentioned processes.

I will not here recapitulate the properties of this acid, which are described in my former papers on the subject, and in that of Menschutkin, who has also considered the constitution of the compound. The uramidobenzoic acid is particularly remarkable for the great number of derivatives it is capable of yielding, being surpassed by but few organic compounds in this respect. It is my intention in this communication to describe several of these derivatives.

Action of Strong Nitric Acid on Uramidobenzoic Acid.

When uramidobenzoic acid, deprived of its water of crystallisation, is gradually introduced into well-cooled fuming nitric acid that has been freed from nitrous acid, it is dissolved in large quantities, and without any evolution of gas. The solution, when nearly saturated, is allowed to stand for about one hour, and then poured into a large quantity of water, taking care to avoid rise of temperature. By this means an abundant yellowish-white crystalline precipitate is obtained, having strongly marked acid properties. It is soluble in alcohol, and is easily so in ether, even in the cold, crystallising therefrom in yellowish-white needles, which have the composition—

$$C_8H_6N_4O_7.$$

In spite of their appearance, however, they are by no means homogeneous, consisting, as I have ascertained, of three different acids, all of which have the formula $C_8H_6N_4O_7$, so that they may be regarded as isomeric dinitro-uramidobenzoic acids, $C_8H_6N_4O_6 = C_8H_6(NO_2)_2O_3$. Although I have not yet been able to completely separate these acids from one another, owing to the great similarity of their properties, the following facts leave no doubt as to the correctness of this view regarding their nature:—

Decomposition of the Isomeric Dinitro-uramidobenzoic Acids by Boiling with Aqueous Ammonia.

When the solution of the three isomeric dinitro-acids in aqueous ammonia is boiled for some time, decomposition ensues, resulting in the formation of three new isomeric acids of the formula $C_8N_7N_3O_5$, as represented in the following equation:—

$$\underbrace{C_8H_6N_4O_7}_{\text{Isomeric dinitro-acids.}} + H_2O = \underbrace{C_8H_2N_3O_5}_{\text{New isomeric acids.}} + \underbrace{NHO_3.}_{\text{Nitric acid.}}$$

From a consideration of the composition of these new acids, it will be evident that they may be regarded as mononitro-uramidobenzoic acids, which view is, moreover, confirmed by their chemical reactions. By taking advantage of the difference in the solubility of their respective barium salts, they may be separated from one another. The following are the particulars of their preparation:—The dilute ammoniacal solution of the mixed dinitro-uramidobenzoic acids is kept boiling for about an hour, when the decomposition may be regarded as complete. A sufficient quantity of barium chloride is then added to the hot solution, and, on cooling, a considerable amount of needle-shaped crystals separate, which consist of the barium salt of one of the new acids, the β nitro-uramidobenzoic acid. When the mother-liquor separated from these crystals is sufficiently concentrated by evaporation, another barium salt begins to separate, the quantity of which may be considerably increased by allowing the solution to stand for some hours. The yellowish-white salt thus obtained appears amorphous to the unassisted eye, but on careful inspection will be seen to consist of minute needles. The acid corresponding to this salt I propose to call α nitro-uramidobenzoic acid.

In order to obtain the barium salt of the third nitro-acid, the γ nitro-uramidobenzoic acid, the mother-liquor from the previous salt is evaporated nearly to dryness on the water-bath, and the resulting mass washed with cold water.[*] The residue, when crystallised from hot water, taking care to avoid too long boiling, yields the pure barium salt of γ nitro-uramidobenzoic acid in bright yellow scales.

As regards the separation of the three nitro-acids in question for their respective barium salts, this is easily effected by adding a slight excess of hydrochloric acid to the hot aqueous solution of the latter,—the acids crystallising out on cooling.

α *Nitro-uramidobenzoic Acid*, $C_8H_1(NO_2)N_2O_3$.—This acid crystallises in bright yellow needles or small plates, which are difficulty soluble in hot water, and but very slightly so in cold water and ether. Boiling alcohol dissolves it readily. It salts have the general formula $C_8H_6(NO_2)N_2O_3,M'$, and are, as a rule, soluble with difficulty.

β *Nitro-uramidobenzoic Acid*, $C_8H_1(NO_2)N_2O_3$.—This acid crystallises from its hot aqueous solution in very slender bright yellow needles, closely resembling in appearance its barium salt previously described. It is nearly insoluble in cold water, and only very slightly in hot; by boiling alcohol, however, it is taken up in considerable quantities. It is monobasic like the α acid.

γ *Nitro-uramidobenzoic Acid*, $C_8H_6(NO_2)N_2O_3$, is obtained in small yellow scales, which are but very slightly soluble in all neutral solvents. It is monobasic, and almost all its salts are more readily soluble than the corresponding salts of the other isomeric acids; moreover, it is readily distinguished by the decomposition which it under-

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[*] A paper read before the Royal Society.

[†] *Zeitschr. f. Chem.*, 1868, p. 389.

[‡] *Deut. Chem. Ges. Ber.*, 1869, p. 47.

[‖] *Ann. der Chem. u. Pharm.*, vol. cliii., p. 83.

[*] The washing contains, besides ammonium and barium chlorides, another barium salt, crystallising in yellowish-red needles, which I shall revert to further on.

goes when boiled with water for a considerable time. It is then gradually dissolved, splitting up in the following manner:—$C_8H_4N_3O_5+H_2O=C_8H_6N_2O_4+CO_2+NH_3$.

The compound $C_6H_6N_2O_4$ thus formed is also an acid, which will be described further on. The salts of the γ nitro-acid likewise suffer a similar decomposition when their aqueous solutions are boiled; and the substance previously mentioned in footnote, as crystallising in yellowish-red needles, is the barium salt of the acid $C_6H_6N_2O_4$, formed in this way.

Action of Tin and Hydrochloric Acid on the Isomeric Nitro-uramidobenzoic Acids.

When α nitro-uramidobenzoic acid is heated with tin and hydrochloric acid, it is reduced in the ordinary way, yielding α amido-uramidobenzoic acid,—

$$C_8H_9N_3O_3=C_8H_7(NH_2)N_2O_3,$$

crystallising in scales, ordinarily of a greyish-white colour. It is slightly soluble in boiling water, still less so in hot alcohol, and almost insoluble in ether. Its silver salt is a white precipitate, having the formula $C_8H_8N_3O_3Ag$. Its hydrochloric acid compound, $C_8H_9N_3O_3,HCl$, crystallises in scales, and is marked by its great insolubility in hydrochloric acid, even when very dilute. When the aqueous solution of the latter compound is acted upon with sodium nitrate, an azo-compound, crystallising in needles, separates. which is soluble in hydrochloric acid.

β nitro-uramidobenzoic acid also, when treated with tin and hydrochloric acid, is converted into an amido-acid, $C_8H_7(NH_2)O_3$, isomeric with that last described. This new acid, which I call β amido-uramidobenzoic acid, crystallises in white scales, rather insoluble in hot water, and extremely so in cold. Curiously enough, it does not possess the property of combining with acids, but with bases it forms salts having the general formula—

$$C_8H_8N_3O_3,M.$$

Its silver salt is a white crystalline precipitate. This new amido-acid is remarkable for its instability; boiled with hydrochloric acid or with baryta-water, it is decomposed in the following manner:—

$$\underbrace{C_8H_9N_3O_3}_{\beta\text{ amido-uramido-benzoic acid.}} = \underbrace{C_8H_6N_2O_3}_{\text{New acid.}} + \underbrace{NH_3}_{\text{Ammonia.}}$$

The new acid, $C_8H_6N_2O_3$, thus obtained forms small white nodules, which are insoluble in all ordinary neutral solvents. It combines with ammonia, forming a salt which crystallises in difficultly soluble long needles. Its hot ammoniacal solution, when mixed with barium chloride, solidifies to a pulp of white needles, which, when dried between filter-paper, have the composition $(C_8H_5N_2O_3)_2,Ba+4H_2O$. With respect to its constitution, I am inclined to regard it as amidobenzoic acid, in which one atom of hydrogen is replaced by the group—

$$(CO)N,(C_8H_6N_2O_3=C_1H_4(NH_2)((CO)N)O_2),$$

and therefore propose to call it β amidocarboxamidobenzoic acid.

γ nitro-uramidobenzoic acid, when treated with tin and hydrochloric acid, behaves differently from either of the other isomeric acids, not yielding an amido-acid, but suffering at once a much deeper decomposition, as represented in the following equation:—

$$\underbrace{C_8H_6N_3O_5}_{\gamma\text{ nitro-uramido-benzoic acid.}} + H_6 = \underbrace{C_8H_6N_2O_3}_{\text{New acid.}} + \underbrace{NH_3}_{\text{Ammonia.}} + \underbrace{H_2O.}_{\text{Water.}}$$

This new acid, $C_8H_6N_2O_3$, which has the same composition as the β amidocarboxamidobenzoic acid just described, is not identical but only isomeric with it, and I shall therefore designate it by the name of γ amidocarboxamidobenzoic acid. It crystallises in white needles, which are almost insoluble in water, alcohol, and ether.

Action of Strong Nitric Acid on the Isomeric Nitro-uramidobenzoic Acids.

In the earlier part of this notice it was stated that three isomeric dinitro-uramidobenzoic acids were produced by the action of strong nitric acid on uramidobenzoic acid, but that their separation could not be conveniently effected, owing to the great resemblance in their properties. Any of these isomeric dinitro-acids, however, may be obtained in a pure state by dissolving the corresponding nitro-uramidobenzoic acid in fuming nitric acid, free from nitrous acid. On diluting the solution with water, the dinitro-acid is precipitated in the crystalline state. It will be seen from the following description of their properties how closely they resemble one another.

α Dinitro-uramidobenzoic Acid, $C_8H_6(NO_2)_2N_2O_3$.—It crystallises in yellowish-white needles, which are very readily soluble in alcohol or ether, but scarcely so in cold water. On the addition of barium chloride to even a very dilute ammoniacal solution of the acid, a bright yellow precipitate is produced, consisting of very small nodules, which in their turn are built up of microscopic needles or plates.

β Dinitro-uramidobenzoic Acid, $C_8H_6(NO_2)_2N_2O_3$, has the same crystalline form as the α acid, which it also closely resembles in its solubility, although it would seem to be somewhat less soluble in alcohol and ether. Its barium salt is a yellow amorphous precipitate.

γ Dinitro-uramidobenzoic Acid, $C_8H_6(NO_2)_2N_2O_3$.—This acid crystallises in yellowish-white plates or needles, which behave towards solvents in a manner similar to the α acid. Its barium salt is obtained in long slender yellow needles, when a solution of the acid in ammonia is decomposed by barium chloride, and is somewhat more readily soluble than the corresponding salts formed by the two before-mentioned acids.

It can be readily understood that when an ammoniacal solution of either of these isomeric dinitro-acids is boiled for a considerable time, that it will be again re-converted into the corresponding mononitro-acid in a manner similar to that previously described as taking place with the mixture of the dinitro-acids:—

$$\underbrace{C_8H_6(NO_2)_2N_2O_3}_{\begin{array}{l}\alpha\\ \beta\\ \gamma\end{array}\left\{\begin{array}{c}\text{dinitro-uramido-}\\ \text{benzoic}\\ \text{acid.}\end{array}\right.} + \underbrace{H_2O}_{\text{Water.}} = \underbrace{C_8H_4(NO_2)N_2O_3}_{\begin{array}{l}\alpha\\ \beta\\ \gamma\end{array}\left\{\begin{array}{c}\text{nitro-uramido-}\\ \text{benzoic}\\ \text{acid.}\end{array}\right.} + \underbrace{NHO_4}_{\begin{array}{c}\text{Nitric}\\ \text{acid.}\end{array}}$$

(To be continued).

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

XIII.

Bone, when dry, consists of one-third organic matter, two-thirds inorganic, as phosphate of lime, carbonate of lime, and phosphate of magnesia.

Teeth contain the same materials, but in different proportions; thus the enamel contains only 2 per cent of organic matter, phosphate of lime 88·5, carbonate 8, phosphate of magnesia 1·5, and trace of fluorine.

In proportion, the older the subject the more calcareous the bones—in old age being brittle, in youth soft and bending.

Muscles contain inosin, kreatin (5 grs. to the lb.), kreatinine, fibrin, fat, sarkosin, ozmozome developed by roasting, and a matter allied to hæmatine; also syntonine.

Sweat contains about 1 per cent of solids, as chloride of sodium and urea; it is also said to contain free lactic acid, and lactates, butyrates, and acetates of ammonia and soda. Carbonic anhydride is exhaled from the skin. The skin is capable of absorbing soluble matter placed in contact with it, under certain conditions.

Horns, hoofs, hides, nails, feathers, &c., are composed of gelatin, it being from these and bones that glue is extracted.

Mucus, a viscid fluid secreted by the various mucous membranes, contains soluble salts, lactic acid (?), and a principle mucin, turned yellow by nitric acid, not precipitated by mercuric chloride, but coagulated by alcohol; it also contains corpuscles and a trace of fat; its use is to moisten the parts by which it is secreted.

Fœces consist chiefly of unaltered food, bile, and some excreted matters. Marcet discovered a crystallisable body insoluble in water, which he named excretinose. The average amount passed daily is 5½ ounces.

Tears are allied to sweat, containing more sodium chloride.

Cerumen, or wax, secreted by the follicles of the external auditory meatus, consists of the ordinary fats, with a trace of colouring matter.

Pigment is not formed in sufficient quantities to determine its constitution; but, from certain microscopical experiments, one would incline to suspect in some parts free carbon.

Semen, characterised mainly by the spermatozoa, has as yet yielded but little information to the chemist.

The menstrual fluid, occurring periodically, is merely altered blood; it has an acid reaction from the mucus of the vagina, is of a dark colour, and is said not to coagulate. This is untrue, as numerous cases under my observation have yielded distinct clots.

The brain has never been subject to thorough investigation; it contains about 80 per cent of water, 0·7 of albumen, cholesterine in considerable quantities, olein, stearin, serolin, and cerebric and oleo-phosphoric acids. Cerebric acid is said to be free, and also united with soda; it is white, insoluble in water, but freely so in boiling alcohol and ether; water causes it to swell up; 9 per cent of phosphorus and 2·3 of nitrogen form part of its composition. Oleo-phosphoric acid is of doubtful existence. The brain contains large quantities of phosphorus in the form of phosphoric acid in combination.

ON THE SPECTRUM OF HYDROGEN AT LOW PRESSURE.

By G. M. SEABROKE.

During the late summer months I have been comparing the lines given by hydrogen in the spectroscope with the lines of the solar spectrum, for the purpose of ascertaining whether any lines in the sun's chromosphere were due to hydrogen, besides those usually supposed to be due to this element. The observations are, as yet, incomplete; but as it will be some months before I can again proceed, I therefore produce the results obtained up to the present time. The experiments have been conducted in a room adjoining the Temple Observatory lately erected at Rugby. My mode of proceeding has been briefly as follows:—I use a vacuum tube containing hydrogen, and connected with a Sprengel's air-pump. The tube is of the ordinary form, having the part between the bulbs, into which the platinum wires pass, about 1-40th inch internal diameter. The pressure in the tube varied from 3 to 4 m.m. of mercury. Preliminary experiments showed that at this pressure the lines appeared most distinct; but a slight change of pressure near 4 m.m. made little alteration in the lines. There is a battery of 12 Smees to work the coil for passing the spark in the vacuum tube. The light from the hydrogen tube passed through a lens which concentrates it on the slit of the spectroscope. A dispersive power of 4 prisms of 60° was used, the arrangement of the instrument being such that the ray of light traverses each prism twice. The room is kept perfectly dark, and sunlight is reflected down from the roof by means of a heliostat. At first I tried the usual mode of comparing spectra, viz., by having the hydrogen and solar spectra side by side. I found this answer very well for the bright lines, but the faint ones could not be distinguished by the side of the bright solar spectrum. I therefore placed a very fine platinum wire in the eyepiece of the spectroscope, and brought the lines under examination into coincidence with the wire, and then passed the sunlight in, and found which black line coincided with the wire, or, where there was no coincidence, the position of the wire with respect to the black lines. I have made from ten to twenty observations on each line that I have at present examined. I have every reason to believe that the limit of error is within two divisions of Fraünhofer's scale either way. The table below gives the positions of the lines I have already compared. These I hope to examine again next year, and also to finish the remainder.

Reference No.	Position on Kirchhoff's Scale.	Relative Brightness. 10=brightest.	Remarks.
1	694	10	C.
2	881	—	Limit of a number of close lines towards C.
3	930	5	Brightest red line, except C.
4	1014	5	Suspiciously near the chromosphere line near D.
5	1049	3	The positions of these were taken by reference to the mercury lines, and are, therefore, not so reliable as the others.
6	1061	4	
7	1119	3	
8	1533	4	
9	1621	4	
10	1876	4	
11	1943	3	
12	1991	6	
13	2065	3	
14	2080	10	F.
15	2235	4	Near here, exact place uncertain.
16	2361	6	
17	2428·5	—	Limit of a band towards F.
18	2540	2	
19	2605	3	
20	2670	3	
21	2767	—	Faint band.

On comparing the above table with the catalogue of chromospheric lines by Professor Young, published in the *Philosophical Magazine* of November, 1871, I see no sufficient signs of coincidence to lead me to believe that any of the chromospheric lines in his list are due to hydrogen, except the C and F already well known to be so due. Since I have not yet examined lines further than 2767, the "near G" (2796) and *h* lines, also known to be due to hydrogen, are not mentioned in the above list. In these experiments a spectroscope with a large dispersive and magnifying power was found to be required in order to identify the lines in the solar spectrum, so that the hydrogen spectrum became so reduced in brightness that, in order to see the fainter lines, the eye required to be kept for some minutes in the dark room, although with a spectroscope of low power the spectrum appeared very bright and full of lines.—*Monthly Notices of the Royal Astronomical Society.*

ON THE MANUFACTURE AND REFINING OF SUGAR.*

By C. HAUGHTON GILL.

(Concluded from p. 105.)

We had a quantity of crystals of sugar floating in a very hot saturated solution. The mass becomes cold, and what happens? The hot saturated solution deposits some of the body, which it held in virtue of its heat, and this sugar deposited from the hot solution forms round the crystals and sticks them all together. It cements this

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* The Cantor Lectures, delivered before the Society of Arts.

quantity of crystals, and binds them into a firm mass. This loaf of sugar has been treated in this way. It was then sent up to the working floors; a pricker was put in to clear the opening, and the mass was allowed to drain for about two days. In the course of that time a considerable quantity of syrup has drained away from it, but, as you will notice, the sugar is by no means white. It consists of a porous mass of sugar crystals, penetrated all through by syrup. When it has drained away, it leaves an apparently dry mass of sugar, but still soft and crumbling, although sufficiently hard to bear handling. This is not pure sugar yet, there are still crystals of sugar wetted with the syrup; although it is true this syrup is purer than that surrounding the crystals of raw sugar, still it is not a solution of pure sugar. Here is a specimen of the syrup that has drained away, though it may not be a fair specimen of that syrup from this mould, as it may have come from sugar of lower quality. Still the syrup is somewhat dark coloured, and the darkness of the colour arises from the fact that when this apparently slightly coloured liquid which I showed you before, is concentrated, a good deal of the water is removed, and a large portion of the sugar forms itself into essentially white crystals, so that all the remaining colouring matter (together with all the other impurities) has become accumulated in this portion which subsequently drained away. The syrup having drained away as much as possible, the loaf consists of sugar crystals wet with a solution of sugar *plus* the impurities which had not been removed by the previous processes. The refiner then has next to remove from this so-called "green loaf" the adhering syrup which contains the impurities; and the way he does it is to replace this impure syrup by a pure one. That is effected in this way. The loaf is kept in the mould, and on the surface a saturated solution of perfectly pure sugar —at least as perfectly pure as can be obtained on a large scale—is poured. Here is a specimen of a solution such as is actually employed in the refinery for that purpose. As this solution is already saturated before being poured on the face of the mould, there is no fear of the water present dissolving any of the sugar of the loaf. It gradually percolates down, and as it goes it displaces the green syrup still adhering to these crystals of sugar. It gradually pushes that out before it, and this clear liquid, the "fine liquor" as it is technically termed, is kept running on the face of the mould until the loaf is thoroughly purged from the original green syrup with which the mass was wetted. When the workmen know that is the case, they remove the rough surface from the face of the sugar by a fitting tool, and then it is in this state, and the loaf is then perfectly white, but still wet. The loaf I showed you before was wet with the coloured syrup, that has now been replaced by the clear one, but it is still wet, and all that has to be done is to finish draining it, and then to dry it thoroughly. This drying is accomplished by putting these loaves into large chambers, heated by steam, which are technically termed stoves. Although they are always heated by steam, they are, nevertheless, called stoves, so that whenever a fire happens in a sugar-house it is always said to commence in a stove. In these large chambers, heated by steam-pipes, the loaves are kept for four or five days, until they are thoroughly dry, when they are fit for the market. There is a loaf on the table, but it has not been in the stove, the wrong specimen having been sent by mistake; it has only been drained but not dried. If it had been four or five days in the stove it would have been harder, but of course of the same quality. Of 100 lbs. weight of this sugar 99¾ lbs. would consist of absolutely pure sugar; indeed, I may say there is no loaf sugar which you buy which has not over 99½ per cent of true sugar in it, so that you need not fear there is any great difference in the sweetening qualities of the various specimens of sugar, whether it be obtained from cane or beet-root.

I have now sketched an outline of the processes used in working up cane or beet-root sugar into the white loaf you see before you, but I daresay the question occurs to you, what becomes of all the syrup that has drained away. The syrup that drains away from the loaf in the first case is, as I showed you just now, somewhat lightly coloured, and contains some impurities. That is returned to the vacuum pan, and again concentrated until a certain amount of grain has been obtained in the pan. It is then allowed to stand for a few hours, and then passed into the centrifugal machine, to separate the grains from the syrup in which they float. This syrup is of course more impure than that employed, and consequently is much more sticky and darker in colour, and altogether less valuable for obtaining crystals from. However, a considerable quantity of sugar is actually obtained, but it has small and confused grains. I have here some such sugar as it comes from the centrifugal machine, and this we may take as the first product which is obtained from this syrup which has drained from the loaves. This consists of very small crystals, but if they are very small, for the same weight there must be a vastly increased surface, and as there is a greater surface, there is more room for the syrup to stick to, and, consequently, they will actually retain more syrup about them than crystals of a better quality. And not only so, but the syrup itself is more impure. Accordingly, this sugar is somewhat inferior in true sweetening power to what I showed you just now. This soft yellow sugar contains a certain amount of impurities adhering to the crystals, but still contains 87 to 93 per cent of pure sugar, and 3 to 7 per cent of altered sugar possessed of sweetening powers, the remainder consisting of 3 to 5 per cent of water, and a small quantity of salts and colouring matter. It is quite clean and wholesome, aud only differs from raw sugar in having a better colour, and in being free from insoluble impurities. In sweetening power it is only inferior to loaf, *i.e.*, pure sugar, as 9 or 9½ is less than 10.

From this first soft yellow sugar a syrup has been drained away, which is still darker in colour than that which I have just referred to. This, in its turn, is concentrated, but, of course, it is a highly impure solution, and contains a great quantity of sticky bodies and salts of various kinds—common salt and gummy bodies of different kinds. Still, however, it contains sugar; therefore it is concentrated, and the liquid, which contains generally a very small proportion of grain in the pan, is allowed to stand in tanks for several days. At the end of that time, the syrup, or jelly as it is called, is filled with a number of grains of sugar. These are separated by a centrifugal machine, and there is then a second quality of brown sugar produced in this way. Here, again, you have still smaller crystals as a rule, and they are surrounded with an excessively impure syrup, so that this sugar is really much more impure than the last, as well as darker in colour. I shall have to say a word on the impurities present in it, and in this I believe I am somewhat singular in my views. I believe the sugar present is not merely pure sugar wetted with a solution or syrup, but I believe in this case some of the impurities are actually in combination with the grains of sugar. Then what becomes of the syrup from this last process? It is now so impure, and contains so large a proportion of bodies which are not sugar at all, that practically it is not worth any one's while to try and get the sugar out of it. Therefore, the syrup from this last portion, a very thick and dark-coloured body, is boiled with water, and allowed to cool, when it is called treacle. I have been asked what is the difference between treacle and golden syrup, and I may saw that golden syrup is nothing but treacle passed through animal charcoal and made a little brighter.

Now, I come to the great question of what is treacle? This was a moot point for a long time. Molasses, whether from cane or beet-root, possess very much the same properties, and the explanation of their constitution rests on the same basis. Taking refinery treacle as my example, I must first tell you what it consists of. Treacle contains, speaking roughly, about 35 per cent of true sugar, about

30 per cent of that inverted or uncrystallisable sugar which is produced by the action of acids or ferments upon cane sugar, about 20 per cent of water, and about 15 per cent of bodies that we know little or nothing about, but which we may class under the general name of dirt, but which certainly include many salts of potash and soda. Then you may say, as it contains 35 per cent of crystallisable cane sugar, why is not that got out in a saleable form and sent into the market. Practically, it cannot be done. It is true that this solution still contains water, and we may regard the syrup therefore simply as a saturated solution of these various bodies in water, and the question is, why don't you continue the operations which were previously performed, and drive off from the treacle, by means of heat in a suitable apparatus, some of the water, making the solution into a supersaturated one, allow it to stand, and then separate the remaining mother-liquid from the crystals which were formed? Practically, you cannot do it. You have not got merely sugar and water, but other bodies which require water to hold them in solution; especially those bodies which I call dirt are mostly uncrystallisable gummy bodies and salts, and you have besides that this uncrystallisable sugar; and all these bodies require a certain amount of water to keep them in solution. If you drive off the water which is required to hold them in solution, you convert this stuff into something like hard-bake. Now, if you had a quantity of hard-bake or toffee with crystals of sugar dispersed through it, it would not be a very promising task to get the crystals out of the mass, and that is what, practically, you would have to do if you tried to concentrate the treacle much further. Evaporation has been carried to such a point that if you drive more of the water out, the impurities, or those bodies which are not sugar, will simply set solid, and prevent the recovery of any sugar crystals that might be formed, even if you could get them to form. Moreover, even if you were not to drive it to this extreme point, but merely drove off some, and so contented yourself with a very small yield of sugar, you are met by this difficulty, that when sugar is held in a solution containing alkaline salts, chlorides, nitrates, and so on, of sodium and potassium, it actually forms combinations with these salts, and these compounds are bodies which, although they do crystallise, do so with such extreme slowness that, unless you could allow the concentrated mass to stand for a very unreasonable time, it would still all remain fluid, and, accordingly, you are practically unable to win more sugar from molasses on a large scale than is actually done. Of course, in a laboratory experiment it is a different matter, and there possibly you might obtain the whole of the sugar.

I have now treated as fully as I can of the processes to which sugar is submitted in the refinery, although, as I told you, I have not been able to enter into the technical details. I have therefore only now to thank you most heartily for the kind attention with which you have listened to the remarks I have made on the various manufacturing operations connected with sugar.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 20th, 1872.

E. W. Binney, F.R.S., F.G.S., President, in the Chair.

Dr. J. P. Joule, F.R.S., described some experiments he had been making on the polarisation by frictional electricity of platina plates, either immersed in water or rolled together with wet silk intervening. The charge was only diminished one-half after an interval of an hour and a quarter. It was ascertained both in quality and quantity by transmitting it through a delicate galvanometer. He suggested that a condenser on this principle might be useful for the observation of atmospheric electricity.

"*On an Electrical Corona resembling the Solar Corona*," by Professor Osborne Reynolds, M.A.

The object of this paper is to point out a very remarkable resemblance between a certain electrical phenomenon (which may have been produced before, although I am not aware that it has) and the solar corona. This resemblance seems to me to be of great importance, for the striking features of these two coronæ are not possessed by any other halos, coronæ, or glories with which bright objects are seen to be surrounded.

Until the eclipse of 1871 there was considerable doubt how far the accounts given by observers of the corona could be relied upon; but Mr. Brothers's photograph has left no doubt on the subject. In this photograph we have a lasting picture of what hitherto has only been seen by a few favoured philosophers, and by them only during a few moments of excitement.

This picture shows the beautiful radial structure of the corona, the dark drifts which intersect it, and also shows the disc of the moon, clear and free from light. I have not yet seen any of the photographs of the last eclipse, but I hear there are several, and that they show the radial structure and rifts even more distinctly than this one does, but whether they do or not one photograph is positive evidence; the absence of more simply means nothing.

The features to which I refer as those which distinguish the solar corona are—

(1). Its rifts and general radiating appearance.

(2). The crossing and bending of rays.

(3). Its self-luminosity shown by the spectroscopic observations of Professor Young.

(4). The way in which its appearance changes and flickers.

When taken in connection with the blackness of the moon's disc, which shows that the corona does not exist or owe its existence to matter between the moon and the plate on which the photograph is taken, these features show that we see on the card the picture of something which actually existed in the neighbourhood of the sun; that the bright rays which we see photographed were actually bright rays of light-giving matter; standing out from the sun an enormous distance. The rifts and general irregularity of the picture show that these rays do not come out uniformly all over the sun's surface, but that they are partial and local, in some places thinly distributed and in others absent altogether. The rays are not all of them straight or perpendicular to the sun's surface.

Such bright rays as these cannot be the result of the sun's light or heat acting on an atmosphere or matter circulating in the form of meteorites. If they are due to the action of the sun's light or heat at all it must be acting on matter distributed in the rays we see, for the sun's light and heat coming out uniformly all round would illuminate any surrounding matter, if at all, so as to show its figure.

The picture irresistibly calls up the idea of a radial emission. If it is the picture of distributed matter, that matter must exist in the form of streams leaving the sun; if it is the picture of some light-producing action, this also must exist in the form of an emission from the sun.

Such, then, are the extraordinary features of the solar corona, and, as I stated, they resemble those of an electrical corona. Any one who is familiar with the various forms of electrical disruptive discharge will recognise the general resemblance they bear to an electric brush. But to the electric phenomenon I am about to describe it is no mere general resemblance, it is an actual likeness with every feature identical.

Before describing the phenomenon I may be allowed to state how I came to notice it. It will be remembered that in a former communication to this Society, I ascribed the phenomena of comets and the corona to a certain electrical condition of the sun. Well, the peculiar appearance of Mr. Brothers's photograph induced me to try if a brass ball, brought into the condition I had ascribed to the sun, would give off a corona presenting this appearance.

The phenomenon is produced by discharging electricity from a brass ball in a partially exhausted receiver. To do this there is no second pole used, the objects which surround the outside of the glass probably answering to this purpose. In order to produce the desired appearance a certain relation is necessary between the pressure of the air and the intensity of the discharge. It is produced best when the receiver is a glass globe insulated on a glass stand, the ball being supported in its middle by a rod coated with india-rubber, to prevent its discharging and spoiling the effect. It is only negative electricity that is discharged into the globe. What becomes of this electricity is not clear; when a machine is used it probably distributes itself on the inside of the glass, and induces a corresponding charge on the outside. When the coil is used it must escape back, for I have had it going for hours without any variation.

There is great difficulty even when the apparatus is right in producing the corona; using a large coil I just exhausted the receiver till the pressure was equal to half an inch of mercury; then there was no appearance of a corona, but one more resembling what is seen in a Geissler tube. I then let the air in gradually, and as the pressure rose the appearance changed at first to a most extraordinary mass of bright serpents twining and untwining in a knot round the ball, then to the branches of an oak tree, and as the pressure kept increasing I gradually observed amongst the branches a faint corona, which I saw at once was what I was looking for; it was formed of pencils of light, forming a light radiating envelope round the ball, diminishing in brightness as it receded from the ball; the tree gradually died out until there was nothing left but the bright radiating envelope, out of which a bright ray would occasionally flash. The diameter of this envelope was about three or four times that of the ball. It was not steady, but flickered, so that it would appear to turn round; it consisted of pencils, or, as they are termed, bundles of rays, between which there were dark gaps. These gaps moved round about the ball; subsequently, however, by sticking sealing-wax on the ball, I rendered them definite and permanent. As the pressure of air increased, the brush became fitful, and finally ceased altogether. It was best when there was about 4 inches of mercury in the guage. By varying the action of the coil I could do with different pressures of air, and hence I assume that there is a definite relation between the intensity of the charge in the ball and the pressure of the air surrounding it under which the phenomena can occur.

The appearance is very faint; so faint that it is difficult to see it even when close to the ball, and I find that it takes some time before the eye can fully appreciate its beauty. It was unfortunately so faint that Mr. Brothers was unable to photograph it. The plate was exposed ten minutes, but there was not the slightest trace of anything on it.

This corona when compared with the solar corona has the special features—

(1). The rifts and general radial appearance, including the bending and crossing of rays.

(2). The self-luminosity.

(3). The changefulness and flickering.

There is one point in which it differs from the solar corona, but this is no more than must be expected. The shading-off of the light in the solar corona is much more rapid than that in its electrical analogue. If, however, the pressure of the air could be caused to vary so that it was denser round the ball, even this difference could be done away with.

In this experiment, then, we have actually produced all the very features which are so extraordinary in the larger phenomenon, and were there no other evidence than this that the solar corona may be electrical, it seems to me that this resemblance constitutes very strong proof. When two things existing at different times, or in different places, resemble each other perfectly, and resemble nothing else in the range of our knowledge, surely that is high probability that they are similar.

We may, however, expect, if the sun is electrical, to find some direct indications of its electricity; nor are such wanting. They are increasing every day. There is the sun's effect on the electricity of the earth's atmosphere, its magnetism, and the aurora; the connection between the sun spots and the earth, and the connection between the planets and the sun spots, as shown by M. De la Rue and Dr. Balfour Stewart. It must be admitted that there are evident signs of some influence which the planetary bodies have on the sun and it on them; which is not gravity nor the result of gravity, yet the result of heat. Almost all these signs are of an electrical character, and some are electricity itself. Moreover, electricity or electric induction is the only other action at a distance besides gravity and heat that takes place. Is it not, then, probable that this influence is electrical? Are we to reject an hypothesis which explains some of these phenomena, and may explain all, simply because we do not see any cause for the electrical condition of the sun—why the sun should be charged with negative electricity?

Should we have discovered that the sun was hot if we had waited to find out why it was hot? Surely it is sufficient to say that there is no proof that it is not electrical. We may go further than this; for if we may compare large bodies with small, then we may show a possible reason for its being electrified. When two particles of different metals approach or recede from each other they become electrified with opposite electricities. May not the sun be approaching or leaving some other body of a different material? I do not suggest this as a probable explanation, but simply in answer to those who say that it is absurd to suppose the sun can be electrified.

"*On the Electro-Dynamic Effect the Induction of Statical Electricity causes in a Moving Body—The Induction of the Sun a probable cause of Terrestrial Magnetism.*" By Professor Osborne Reynolds, M.A.

If an electrified body was placed near a moving conductor so as to induce an opposite charge in the moving body, this charge would move on the surface of the conductor so as to remain opposite the electrified body, whatever the motion might be. Suppose the moving conductor to be an endless metal band running past a body negatively charged; the positive charge would be on the surface of the band opposite to the negative body, and here it would remain whatever might be the velocity of the band. Now the effect of the motion of this negative electricity on the conductor would be the same as that of an electric current in the opposite direction to the motion of the band.

If instead of a band the moving body consisted of a steel or iron top spinning near the charged body, the effect of the electricity on the top would be the same as that of a current round it in the opposite direction to that in which it was spinning.

It might be that the electricity in the inducing body would produce an opposite magnetic effect on the top; but even if this were so (and I do not think it has been experimentally shown that it would be so), its effect, owing to its distance, would be much less than that of the electricity on the very surface of the top. If we take no account of the effect of the inducing body, the current round the top would be of such strength that it would carry all the electricity induced in the top once round every revolution. And if the top were spinning from west to east by south it would be rendered magnetic with the positive pole uppermost, that is, the pole corresponding to the north pole in the earth or the south pole of the needle.

In order to show that such a current might be produced, a glass cylinder, twelve inches long and four across, was covered with strips of tin-foil, parallel to the axis, with very small intervals between them. These strips were about 6 inches long and ½ inch wide, and the intervals between them the 200th of an inch. In one place there was a wider interval, and from the strips adjacent to this wires were connected by means of a commutator with the wires of a very delicate galvanometer. This cylinder was mounted so that it could be turned twelve hundred revolutions in a minute, and brought near the conductor of an electrical machine. This apparatus, after it had been thoroughly tested, was found to give very decided results. As much as 20° deflection was obtained in the needle, and the direction of this deflection depended on the direction in which the cylinder was turned, and on the nature of the charge in the conductor. When this was negative the current was in the opposite direction to that of rotation. It may be objected that the measurement was not actually made on the cylinder. It must, however, be remembered that it was made in the circuit of metal round the cylinder, and that my object was to find the relative motion of the cylinder and the electricity. Altogether I think it may be taken as experimental proof of the fact previously stated that if a steel top were spinning under the inductive influence of a body charged with negative electricity the effect would be that of a current round the top such as would render it magnetic.

The cause of terrestrial magnetism has not been the subject of so much speculation as many much less important phenomena. It seems to have been regarded as part of the original nature of things like gravity, and the heat of the sun, as a cause from which other phenomena might result, but not as itself the result of other causes.

Yet, when we come to think of it, it has none of the characteristics of a fundamental fact; it appears intimately connected with other things, and when two phenomena have a relation to each other, there is good reason for believing them to be connected, either as parent and child, or else as brother and sister, the one to be derived from the other, or else them both to spring from the same cause.

Now the direction of the earth's magnetism bears a marked relation to the earth's figure, and yet it can have had no hand in giving the earth its shape, which is fully explained as the result of other causes; therefore, we must assume that the figure of the earth has something to do with its magnetism, or what is more likely, that the rotation which causes the earth to keep its shape, also causes it to be magnetic.

If this is the case, then, there must be some influence at work with which we are as yet unacquainted—some cause which coupled with the rotation of the earth results in magnetism. From the influence which the sun exerts on this magnetism we are at once led to associate it with the cause. Yet the cause itself cannot be the result of either the sun's heat, light, or attraction. What other influence, then, can the sun exert on the earth?

The analogy between the magnetism produced by a spinning top by the inductive action of a distant body charged with electricity, and the magnetism in the rotating earth, probably caused by the influence of the sun, which influence is not its mass or heat, seems to me to suggest what the influence which the sun exerts is. If the sun were charged with negative electricity, it seems to me to follow, from what the experiments I have described establish, that its inductive effect on the earth would be to render it magnetic, the poles being as they are.

The only other way in which the sun could act to produce or influence terrestrial magnetism would be by it own magnetism. If the sun is a magnet, it would magnetise the earth. If this is the cause the sun's poles must be opposite to those of the earth. Now, it follows that such a condition of magnetism would or might, if its materials are magnetic, be caused by the rotation of the sun under the inductive action of the earth and planets in exactly the same way as that caused in the earth by the inductive action of the sun. As the direction of the rotation is the same in both bodies, and the electricities of the opposite kind, the magnetism would be of the opposite kind also. So that on this hypothesis it is probable the sun would act by both causes.

When I first worked out this idea, I was not aware that anything like it had been suggested before; but Mr. Baxendell, after having seen my experiments, noticed a review of a book on terrestrial magnetism, to which he kindly called my attention. The author, without making any assumption with regard to the electrical condition of the sun, assumes it to act on the earth's magnetism precisely as it would under the conditions I have described; and he then proceeds to consider, not only the general features of the earth's magnetism, but all its details—and this in a most elaborate manner—and to show the explanation which this hypothesis offers for them, particularly for the secular variation of the direction of the needle. I am therefore able to speak of the hypothesis as affording an explanation of the numberless variations of the earth's magnetism, as well as of its general features.

GLASGOW PHILOSOPHICAL SOCIETY.
(Chemical Section).

Ordinary Meeting, February 26th, 1872.

Dr. William Wallace, F.R.S.E., President, in the Chair.

A paper was read by Dr. James St. Clair Gray, Assistant to the Professor of Medical Jurisprudence, University of Glasgow, "*On Certain Fallacies in the Means of Detecting some Poisons.*"

The author first treated of such metals as are precipitable by Reinsch's process, showing how they may be distinguished alike from each other and from other metals. He explained the preliminary operations resorted to by himself and the precautions to be observed, and in reference to the deposition of the suspected metals on copper-foil, he said that if after boiling the prepared fluid for half an hour no deposit should show itself on the slip of copper, it should not be inferred that arsenic, antimony, mercury, and bismuth are absent, seeing that arsenic acid, the tersulphide of arsenic, realgar or the bisulphide of arsenic, and the sulphides of mercury, do not, under certain circumstances, yield a metallic deposit by Reinsch's process. A freshly prepared solution of arsenious acid readily yields a metallic deposit by Reinsch's process, but if the solution be exposed to the air for some days it may be impossible to obtain the usual deposit of metallic arsenic owing to the conversion of the arsenious into arsenic acid, the presence of which in the solution may be proved by the formation of a brick-red precipitate, by using argentic nitrate; and the arsenic acid may be reconverted into arsenious acid by passing a current of sulphurous acid gas through the solution for two or three hours. This point is of much interest, inasmuch as arsenic administered in the form of arsenious acid may become converted in the body into arsenic acid. If of this substance a quarter or half a grain be diffused in the substance of the liver, weighing, on the average, about 4 lbs. avoirdupois, the limit of its power of producing a deposit would be exceeded, and it might thus easily escape detection. In such a case the source of error might easily and simply be removed by boiling the suspected matters with a small proportion of sulphite of sodium or potassium for an hour and a half, so as to ensure the conversion of the arsenic into arsenious acid. Then, as to the tersulphide and bisulphide of arsenic, neither of which is precipitable by Reinsch's process unless a large quantity be present. In order to obtain proof of the presence of these substances the suspected matters should be boiled with caustic potash, by which means they are brought into solution. The material is then filtered or dialysed, and the clear liquid concentrated. Nitric acid in excess is added, and the excess removed by boiling. If arsenic is present it will now be found as arsenic acid, as may be proved by precipitating with argentic nitrate; and if any other proof be required, sulphurous acid may be used to convert the arsenic into arsenious acid, when its presence may be determined by Reinsch's process, by the sulphuretted hydrogen test, by the ammonio-nitrate of silver test, or the ammonio-sulphate of copper test. When the suspected matters contain the sulphides of mercury, the method is to boil with nitric acid for half an hour, add hydrochloric acid, and proceed with Reinsch's process, the sulphides of mercury being rendered soluble and brought into a fit state for the deposition of the metal in the usual way. Having enlarged upon each of these three metals, the author proceeded to explain how each deposit may be distinguished from the others, and mentioned the circumstances which should excite doubt. In the case of the liquid tests for mercury the author stated that iodide of potassium will give no result in presence of alcohol, chloroform, or ether, although these substances do not interfere with the perfect development of any of the other tests. He urged that the production of a bright green precipitate in searching for arsenic in the humid way is not always to be implicitly relied upon, inasmuch as oxide of silver or oxide of copper may be formed in the course of the operation which very much resembles Scheele's green.

Dr. Gray afterwards gave an account of the method which he had found best in the detection of hydrocyanic acid. When certain precautions are observed he considered the vapour tests by far the best. A number of the necessary precautions were mentioned and enlarged upon. The author concluded his paper by calling attention to the detection of opium, owing to the fact that the operation of detecting that substance is perhaps more frequently called for than that of any other organic poison, and that its separation and identification are at present very complicated.

In the discussion which ensued,

The President asked if it was worth while to proceed with the ordinary chemical tests for hydrocyanic acid if the odour of the substance could not be perceived, to which

Dr. Gray replied that there were persons who had not the special faculty of perceiving the odour of prussic acid, even though their ordinary sense of smell was well developed; and in answer to Mr. Dixon, he said it would be quite possible to differentiate the metals even though two, three, or four should be deposited in Reinsch's process upon a slip of copper.

CORRESPONDENCE.

LOSS OF SODA IN LEBLANC'S PROCESS.

To the Editor of the Chemical News.

Sir,—My attention has been called to a letter from Dr. Wright, in which he criticises a paper read by me before the Chemical Section of the Glasgow Philosophical Society.

The abstract of my paper published in the Chemical News is only of the latter part of it, the first part being taken up altogether with the methods of conducting such experiments, and of sampling, and pointing out the great difficulty in obtaining perfectly accurate results in all such manufacturing operations, and the extreme care necessary in conducting such experiments generally.

It will be noticed that my results are obtained at various periods, and by different methods; in fact, these investigations have been carried on, more or less, for some years.

As regards insoluble sodium compounds, my experience has been that chalk gives more insoluble soda than Irish limestone; but I cannot speak as to the limestone used in the Lancashire district.

The expression used by Scheurer-Kestner, "cette perte semble ne pas rester beaucoup audessous de 5 pour 100 et quelquefois dépasser ce nombre," most certainly does not bear the construction put on it, that the loss "certainly is never less than 5 per cent, and often very much larger," nor could it; while his experiments (of which there are only two) show it to be less than this. Taking his figures which give black ash as containing 18·65 per cent Na, and leaving about 60 per cent of waste, we have, for his two experiments—

	Insoluble.	Soluble.	Total.
1st experiment	5·37	0·54	5·91
2nd ,, ...	3·18	1·38	4·56
Mean	4·27	0·96	5·23

If we take the total loss in the waste, which is the only way in which these results can be compared, we get the figures in the following table:—

Unger.	Kopp.*	Brown.	Muspratt.	Scheurer-Kestner.	Mactear.		Wright.
					Lowest result.	Highest result.	
3·41	14·02	3·24	4·81	5·23	4·40	6·96	9·05

All of these figures, except those of Messrs. Scheurer-Kestner, Wright, and myself, are mere isolated experiments, and useless for comparison; but, comparing the latter, and leaving out my lowest result (obtained in a set of tanks specially fitted up for experiment), I still think Dr. Wright's results "exceptionally high," and necessarily so under the *exceptional* circumstance specially stated by him in his paper, that "the capabilities of the plant were strained to the uttermost, so that the losses are probably the maxima consistent with remuneration;" and in this case, the "two circumstances" which might *possibly* affect my results are quite unnecessary to account for the difference between them and those of Dr. Wright.

The sampling difficulty is very well illustrated by Dr. Wright in reference to the test of the salt-cake employed in his experiments. Average salt-cake gave only 3 per cent of NaCl, or less; while the average of all used in balling process was 5·31 per cent. Daily samples were taken; and "at the end of two or three weeks, as occasion served, these daily samples were respectively mixed together and carefully analysed." Now, unless these samples were mixed in *exact proportion* to the respective quantities of good, "damaged," or "inferior" salt-cake from which they were taken (and which, evidently, in the method described was not the case), the average deduced from the various tests must be perfectly fallacious.

I have no doubt whatever as to the accuracy of Dr. Wright's results, so far as regards the particular samples which he worked on; but, as compared with others, the results are high, and as regards insoluble soda, I think exceptionally so.

I pass over the two circumstances which Dr. Wright advances to account for the difference in our results, merely stating that the effect of the sources of error which he found it necessary to "carefully guard against" are pretty well known to my junior laboratory assistant.

The NaCl in salt must not only be deduced from constant testing, but checked by the produce of salt-cake from salt, taking in stocks; but I have found it much easier to obtain an average sample of salt than of almost any of the other articles connected with the process.

While I believe it to be a well-known trade custom in Lancashire to use 32 as the equivalent of soda, this is not the case in Glasgow, nor in many of the Tyne works.

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* Kopp's result, as quoted by Scheurer-Kestner, is calculated from a *single* analysis of waste, said to contain 7·40 of "sulphide of sodium," equal to 4·36 Na in the waste; but it is not stated even to be an average sample, and is only given in reference to an experiment on the action of the lime in the waste on carbonate of soda in solution.

The statement as to trade analysts of the West of England is for them to consider; but I assert most emphatically that all ash sent out by the firm of which I am a member will bear out the invoiced strength on the basis of 31 as the equivalent of soda.

I dislike exceedingly controversy such as this, but the fact that I am taxed indirectly with ignorance sufficient to make up a standard solution to "show an increase in the yield of 3·2 per cent" must be my excuse for troubling you with this letter, which, so far as I am concerned, terminates the matter.—I am, &c.,

James Mactear.

St. Rollox, Glasgow.

SCIENTIFIC EVIDENCE IN LAW COURTS.

To the Editor of the Chemical News.

Sir,—Dr. Bernays deserves thanks for calling attention to the subject of scientific evidence in the paper which you publish in your last number. Will you allow me to suggest a little closer analysis of the causes of error in our judicial system as applied to scientific subjects? Dr. Bernays, and others who are able and willing to lend real aid in reforming existing evils, may possibly gain something by knowing the sort of view a non-scientific lawyer may take of the province of reform. It is from this standpoint that I trespass on your space.

Two sources of mischief noticed by Dr. Bernays may, perhaps, be separately considered.

(1). The admission of the evidence of unqualified persons.

(2). The insufficient or inaccurate appreciation of evidence, and herein (amongst other things) the confusion between the value of speculation and demonstration.

On the first point, Dr. Bernays offers very intelligible relief—exclude all but specific persons. I have myself heard the statement of a medical practitioner's apprentice, that he had "tested" a knife and found blood upon it, pass unchallenged, and accepted by one of our most respected judges as conclusive proof of the fact. I refrain from speculation on the competency of the witness in this particular case; all I can say is that the point did not seem to suggest itself to Bench or Bar, though the prisoner was in other respects ably defended. The moment the court got on the verge of this *terra incognita*, the usual course of sifting evidence seemed impossible.

The second point is more difficult, and I do not see that Dr. Bernays offers any adequate relief. I observe his suggestions as to procedure, but before discussing the remedy it is worth while to consider how far it is correct to draw a generic distinction between "scientific evidence" and any other evidence.

A witness says "I saw John Smith at such a time and place." This is received, without corroborative evidence of the optical process of seeing, as evidence that John Smith was there, because the facts which connect the presence of John Smith with the statement of the witness are accorded by the tribunal.

A witness says, "I say (from calculation) that the moon at that time on that night was so situated that the wall near which John Smith was standing did not throw a shadow upon him." This would be received subject to proof of the witness's competency to make the calculation, because it would be accorded that the statement could be made from calculation, although the scientific facts and conclusions involved *might* be beyond the comprehension of the tribunal.

A witness says, "I was not present or near the spot, but I say, from a long study of meteorology, that it could not have been raining at that place at that time." This evidence would not have weight, whatever proof might be given that the witness was a scientific man and spoke from the firmest conviction. The tribunal would regard it as a mere expression of opinion, and, if there were any doubt on the subject, would require some corroborative evidence that the subject matter was one of scientific demonstration.

I think these instances will serve to show that there is no difference in kind between scientific evidence and any other evidence; and at the same time to suggest to any one conversant with scientific evidence that the great evil lies in the admission of statements of very different value as evidence of equal weight, merely because the subject is recondite and the tribunal is obliged to surrender the discriminating faculty which it exercises on subjects when the premisses are within its knowledge. Theoretically, according to our present system, the court ought to have the materials before it for verifying all the premisses and testing the conclusions in the same way that other statements are tested. Practically, from the extent of the ground involved, this is impossible; and in the end the tribunal weighs the concrete statements as made (often, as Dr. Bernays suggests, with too much respect for the audacity with which they are made), and treats them as proved or disproved without the sifting which other evidence would receive.

Now if the men having weight in science could provide the tribunals with recognised authority, which would serve as a test whether a statement should be taken as fact or as opinion, if the judge, who can usually appreciate the statements of the mathematician or the accountant, had the means at his side (whether by assessors or by submitting questions to a collateral authority) of appreciating the statements of the chemist and mechanic, the greater part of the evil might be removed. I know the line between speculation and demonstration would still be difficult to draw, but, since all statements must be taken to be on one side or other, let us have the line drawn as accurately as possible.

I make the above remarks merely to indicate the direction in which scientific men can work towards the required reform. They may (although the means of having scientific assessors now exists) have to call in the aid of the jurist before much practical good is brought about; but I think they will do far more by keeping to the narrow ground above indicated than by travelling over the whole field of Dr. Bernays's suggestions. His suggestion about written and published evidence is nothing more than a proposal to adopt as a novelty the ordinary practice of the Court of Chancery. The adoption of a body of arbitrators in nuisance cases is now open to the parties if they prefer it, and he does not suggest that it should be compulsory. The suggestion for the immunity of scientific witnesses from cross-examination *is* a novelty. But why not *all other* witnesses? This is a subject which you will hardly wish discussed at length in the Chemical News.—I am, &c.,

W. P. Beale.

Lincoln's Inn, March 5, 1872.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, February 12, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Reply to Dr. Fremy.—M. Pasteur.—The meetings of the Academy have been of late in a great measure devoted to very lengthy discussions on fermentations, and replies on this subject on the part of different *savants;* this paper is devoted to one of these replies, but the contents are not well suited for abstraction, an observation also applying to the following memoir :—

Communication Relating to the History of Ferments According to van Helmont.—Professor Chevreul.—The celebrated *savant* gives in this memoir a very clear and concise review of the opinions of van Helmont and their scientific value.

Report on a Process of Preserving Grain in a Vacuum.—Dr. Louvel.—This exhaustive essay contains a detailed account of a series of experiments made on the large scale with the view to try the practical value of the author's process for preserving grain, ship-biscuits, and flour, and especially also preventing these articles being damaged by insects, rats, and mice, by placing the same into strongly-made iron (boiler-plate) vessels of sufficient capacity to contain 10 cubic metres (100 hectolitres, 27·512 bushels) of grain or flour, and next, after having hermetically closed the man-hole of this vessel, producing a vacuum in it by the aid of an air-pump, it being sufficient for practical purposes that the vacuum be from 10 to 12 centimetres of mercury, that is, a reduction of about from one-sixth to one-seventh of the ordinary atmospheric pressure. The results of these experiments (sufficient time having been amply given to test their real value) is satisfactory in every respect. The cost of the apparatus, including air-pump, guages, tubing, and fittings, is about £64, but one air-pump can be used for a number of these vessels. It should be observed that the quantity of grain lost or rendered unfit for human food by the ravages of insects, rats, mice, worms, &c., amounts on an average to fully 13 per cent of a crop, while, moreover, by this mode of preserving, much labour required for shovelling grain about in the granaries is rendered unnecessary.

Temperature of the Sun's Surface; Reply to the Rev. Father Secchi, S.J.—E. Vicaire.

Absorption Rays Produced in the Spectrum of Solutions of Hyponitric, Hypochloric, and Chlorous Acids.—D. Gernez.

Morphological Studies on the Various Species of Alcoholic Ferments.—Dr. Engel.—The contents of this paper, illustrated by woodcuts, record a series of morphological researches on the yeast plant, and elucidate the process of fermentation.

Observation Bearing upon M. Boussingault's Communication of Jan. 8 last, on a Saccharine Substance Met with on the Leaves of a Lime-Tree.—Dr. P. Harting.—The author first briefly refers to the communication just named (see Chemical News, vol. xxv., p. 70), and then relates that some years ago he had an opportunity to observe a similar phenomenon in his garden at Utrecht (Kingdom of the Netherlands); in this instance the author found along with the saccharine excretion a number of insects, *Aphistiliæ*, on the tree, and some of these insects were seen quite filled with the saccharine juice, which, on being submitted to chemical analysis, was found to consist essentially of cane sugar. The reading of this paper, wherein the author states that, in his opinion, the secretion of this saccharine juice is due to the punctures made by the insects alluded to in the leaves of the lime-tree, gave rise—First, to an observation of M. Boussingault, who says that Dr. Harting's opinion just alluded to is that generally accepted, but did not hold good in the instance referred to by him; he also states that the leaves of lime-trees contain a rather large amount of cane sugar. Secondly, Colonel Follie states that the phenomenon alluded to is every year observed on the lime-trees planted on the Esplanade at Metz, the abnormal secretion of saccharine matter being so strong that drops of it are continually falling from the trees, which lose their foliage very early in autumn.

This number contains a voluminous account, sent in from a great number of different places, of the aurora borealis observed on Feb. 4 last.

Revue Hebdomadaire de Chimie Scientifique et Industrielle,
January 25, 1872.

Consumption of Gas by Different Burners and under Different Pressures.—E. Lemoine.—This paper contains a concise account of some noteworthy facts in reference to gas-lighting, and to the great importance of selecting burners of good construction and suited to the average pressure of the gas supplied.

Effects of Dynamite; Procès-Verbal of a Series of Experiments made on Jan. 27 last at Fort de Montrouge.—Colonel Barbe and M. Brull, C.E.—This paper contains the record of a very interesting series of experiments made in the presence of His Majesty Don Pedro II., Emperor of Brazil, for the purpose of testing dynamite. We quote for curiosity's sake the following :—An iron-hooped, well-made, oaken cask of 2 hectolitres (rather more than 44 gallons) cubic capacity was placed in a vertical position, then filled with water, and a square hole left in the lid, the size of the hole being sufficient to admit of throwing through it a parcel of four cartridges, each containing 20 grms. of dynamite, care being taken to light the fuses previous to casting the cartridges into the water. After the explosion not a trace even of the cask was to be seen, and on the spot where it had been standing a funnel-shaped hole was formed, 4 decimetres (15·748 inches) deep.

Fire-Clay Gas-Furnace for Heating Small Crucibles.—C. Mène.—The author describes, and illustrates with woodcuts, a very neatly-made apparatus, invented by M. Wiesnegg, at Paris, for heating platinum and porcelain crucibles to a very high temperature; this portable gas-furnace is very well adapted, while, if desired, the flame can be fed by oxygen.

Lithographic Stones Recently Discovered at Menton (Alpes-Maritimes).—C. Mène.—The first portion of a memoir which contains very valuable information on the stone used in lithography in general, and more especially on that recently discovered at the locality above named, and wrought on the large scale by M. Rencurel, who has established works at Santo-Stephano-Mare for preparing this stone (which appears to be of very excellent quality) for use for lithographers.

Formation of Nitrate of Ammonia in the Process of Respiration.—Dr. Struve.—The author states that, by breathing for some moments in a large-sized beaker-glass previously moistened with water, and next rinsing the glass with some pure distilled water, this liquid will be found, by the usual tests, to contain ammonia and nitric acid. This formation of nitrate of ammonia is stated to become increased after dinner has been taken. The author is of opinion that atmospheric nitrogen is not entirely passive in the process of respiration, but it should be observed that this opinion is contradicted by the direct experiments of Drs. Regnault and Reiset.

Application of Ozone for the Purpose of Maturing and Mellowing Alcoholic Liquids—Wine, Brandy, Gin, Rum, &c.—A. Frentz.—Turning to practical account Dr. Loew's observation of the conversion of the oxygen of the air into ozone by passing a current of air over small gas-flames, the author describes in this paper an apparatus fit for causing the ozone thus generated to act upon spirituous liquids, which thereby become matured and mellowed in a very few hours; 40 to 45 hectolitres of brandy (each at 22 gallons) may be thus matured per day, at a cost of about five shillings.

Gazzetta Chimica Italiana, December, 1871.

The title-page of this number is identical with that quoted by us in our issue of Jan. 12 last, but the contents of this number differ, and on the cover is printed a notice from which it appears that the January number of this year was yet in the press on Feb. 14 last. This number contains the following original papers and memoirs :—

Historical Notes and Considerations on the Application of the Atomic Theory in Chemistry, and on the System of Formulæ Used in that Science to Designate the Constitution of Compound Bodies.—Dr. S. Canizzaro.—The continuation of a very ably written monograph on this subject.

Formation of Asparagine in Vetches.—A. Cossa.—After first referring to the researches of the illustrious *savant* Dr. R. Piria ("Studi Sulla Costituzione Chimica dell'Asparagina e dell'Acido Aspartico;" Cimento, Fascicolo di Gennaio e Febbraio; Pisa, 1846) on this subject, and to the conclusion come to by that author that the formation of asparagine was due to the fact that during the growth of the vetches daylight was absolutely excluded, the author next alludes to the researches of Pasteur on this subject (*Ann. de Chim. et de Phys.*, 1857), and then relates at length his experiments on this topic, a portion of vetches being made to grow with complete exclusion, and another portion with full admission of sunlight, in order to ascertain whether the asparagine formed in either case is in all respects identical; this identity was in all respects proved. It appears that the juice of the plant alluded to when grown with the admission of daylight contains a large quantity of a nitrogenous matter, which, by inducing fermentation, causes the decomposition of the juice very rapidly; this nitrogenous matter appears either to be entirely absent in the juice of the plant grown in darkness, or to be present therein only in very small quantity, the consequence whereof is that the asparagine met with in the juice of the vetches grown in daylight is more rapidly destroyed, and hence may have arisen what was not noticed by Pasteur, viz., that the asparagine may entirely disappear from the juice, that chemist operating upon no less than 200 litres of the fluid.

Note on Amido-Sulpho-Benzidic Acid.—L. Pratesi.—The contents of this paper treat on the subject of isomerism of this body, but, as the author admits in a foot-note, this same subject has been recently more fully and completely treated by Dr. E. Kopp.

Ozone and Plants; New Experiments.—G. Bellucci.—Notwithstanding the high scientific merits of this memoir, its contents do not admit of any useful abstraction, an observation also applicable to the following lengthy essay, elucidated by a series of complex formulæ :—

Action of Cyanide of Potassium upon Bichlor-Acetic Acid.—D. Amato.

It would appear that the December number we quoted in vol. xxv., p.22, is the November number of 1871.

Journal für Praktische Chemie, No. 1, 1872.

This number contains the following original papers and essays :—

Uramido-Nitro-Phenylic Acid and some of its Derivatives.—P. Griess.—This essay treats at great length on an acid formed by the action of fusing urea upon amido-nitro-phenylic acid—

$$C_6H_3(NH_2)(NO_2)_2O\,;$$

this new acid, named by the author uramido-nitro-phenylic acid—

$$C_7H_6N_4O_6=C_6H_3\left(\left.\begin{matrix}CO\\H_3\end{matrix}\right\}N_2\right)'(NO_2)_2O,$$

is formed from urea and picraminic, *alias* amido-nitro-phenylic, acid, according to the following formula :—

$$\underbrace{C_6H_5N_3O_5}_{\text{Picraminic acid.}} + \underbrace{COH_4N_2}_{\text{Urea.}} = \underbrace{C_7H_6N_4O_6}_{\text{New acid.}} + \underbrace{H_3N.}_{\text{Ammonia.}}$$

Uramido-nitro-phenylic acid is a solid crystalline body, difficultly soluble in boiling water, hardly at all soluble in that fluid when cold, readily soluble in boiling alcohol. When gently heated, this acid fuses, forming a yellowish coloured oily fluid; at a higher temperature it is decomposed, with a slight explosion. This acid forms with bases crystalline salts, which are rather difficultly soluble in water. The author describes at length the following derivatives of this acid;—Amido-uramido-nitro-phenylic acid—

$$C_7H_8N_4O_4=C_6H_3(NH_2)\left(\begin{matrix}CO\\H_3\end{matrix}\right\} N_2\Big)'(NO_2)O;$$

the hydrochloric acid compound of the last-named substance—

$$C_7H_8N_4O_4,HCl;$$

the barium compound; amido-carboxamido-nitro-phenylic acid; di-amido-carboxamido-phenylic acid.

Action of Fluid Phosgen upon some Amides.—Dr. E. Schmidt.—The contents of this lengthy and very valuable monograph are not suited for abstraction. This portion is divided into the following chapters:—Introduction; action of phosgen upon ureas; carbonyl-diurea-mercuric oxide; action of phosgen upon carbonyl-diurea; action of phosgen upon biuret.

No. 2, 1872.

This number contains the following original memoirs and papers:—

Action of Fluid Phosgen upon some Amides.—Dr. E. Schmidt.—The continuation and end of this lengthy memoir. This portion contains the following sections:—Carbonyl-dibiuret-mercuric oxide; action of phosgen upon carbonyl-dibiuret; action of phosgen upon oxamide, benzamide, and acetamide.

Researches on the Combinations of Tantalum.—R. Hermann.—This very lengthy monograph is divided into the following chapters:—On the proportions wherein the metals of the tantalum group combine with oxygen; on the atomic weight of tantalum; experiments on the preparation of tantalum and on the atomistic volume of the same; tantal-aluminium; oxide of tantalum; hypotantalous acid, Ta_2O_3; tantalous acid, TaO_2; hypotantalic acid, Ta_2O_5; tantalic acid, TaO_3; combinations of the acids of tantalum with bases; tantalum and sulphur; tantalum and chlorine; tantalum and fluorine; compounds of hypotantalum fluoride with fluorine bases.

Schlœsing's Method of Separating Potassa from Soda.—Dr. H. Kolbe.—The author records in this paper a series of experiments made precisely according to the directions given by M. Schlœsing in the *Comptes Rendus*, and, from the results obtained by the German *savant* above named, it appears that perchlorate of potassa is *not* insoluble in alcohol of 36 per cent as stated by M. Schlœsing; the salt alluded to is not even quite insoluble in alcohol of 63 per cent. The author, while not desiring to declare Schlœsing's method to be quite useless, still observes that, unless some more complete and corrected description of this analytical process is given, it is not reliable for accurate analysis.

Polytechnisches Journal von Dr. E. M. Dingler, second number for January, 1872.

This number contains the following original memoirs and papers relating to chemistry and collateral subjects:—

Preparation of Pure Metallic Silver.—Dr. Gräger.—The author dissolves the alloy of silver in nitric acid, taking care to use as small a quantity as possible; the solution is then transferred to a large-sized porcelain basin, and gradually neutralised with previously-lixiviated chalk free from chlorine. The neutralised liquid is next boiled, and chalk again added to it, while boiling, until the fluid has become colourless (in order to test more accurately, a drop of the liquid is poured on a piece of white filtering-paper, and next to that drop is placed one of a solution of ferrocyanide of potassium; as long as the well-known red colouration, copper reaction, hereby ensues, chalk is added). The fluid is next filtered, to separate the carbonate of copper, and the filtrate (a solution of nitrate of silver and nitrate of lime) is again boiled, and either further treated with carbonate of lime or, better still, with carbonate of soda; the bright yellow coloured precipitate thereby ensuing, a mixture of carbonate of silver and carbonate of lime, is washed, dried, and ignited, leaving a greyish white mass of metallic silver mixed with carbonate of lime; this mixture is treated with dilute hydrochloric acid, washed with distilled water, and then fused along with borax, yielding pure silver. The bright green-coloured carbonate of copper can be be used as a pigment for painting purposes.

Industrial Preparation of Tartaric Acid.—Dr. M. Kurtz.—This excellent memoir contains a complete account of the best and most economical methods of preparing tartaric acid on the large scale from the marc of grapes and other substances, by-products of wine-making.

Application of Silicate of Soda in Soap-Boiling.—Guido Schnitzer.—The contents of this lengthy memoir bear completely upon practical soap-making.

Process of Sugar Manufacture Proposed by J. Schröder.—Dr. O. Kohlrausch.—The report on a series of practical experiments made by a committee appointed *ad hoc* to test a peculiar method of sugar-boiling and clearing.

Determination of the Degree of Colouration of Sugar Solutions.—Dr. Stammer.

Submarine Blastings Executed with the Aid of Dynamite by Order of the Imperial Royal Marine at Trieste.—L. Closse.—This paper, illustrated by woodcuts, contains very valuable information on the subject alluded to.

Les Mondes, February 8, 1872.

Aurora Borealis of Feb. 4.—Rev. Lecot (at Noyon).—The author describes in this paper the phenomenon alluded to as carefully observed by him. The aurora has been also seen at Paris, and several spectroscopical experiments have been made with great success.

Aërial Navigation.—Dupuy de Lôme.—The brief account of an aërial journey made by the author in company with fourteen others in a newly-constructed air-balloon and machinery for imparting to this balloon (ellipsoidal shaped, and a capacity of 3500 cubic metres) and the car thereto attached any desired direction and motion, independent of that which the wind or air-currents will give to the balloon. The experiment has proved a complete success in every respect; a speed of 50 kilometres (31·065 English miles) per hour could be readily obtained.

Bibliography.—Under this head we notice here—"L'Année Scientifique" (15th year), par Louis Figuier; last year this well-known book was not published; the author has filled up the gap, and, according to the reviewer (Ch. Boissay), this volume will be consulted by many with great pleasure. "Annuaire de l'Observatoire Royal de Bruxelles" (39th year), par M. A. Quetelet; this work is here highly spoken of, and particular attention called to the excellent notice on the late Sir F. W. Herschel, with whom the editor was very well acquainted. "Mise en Valeur des Sols Pauvres," par M. Alphonse Fillon; the author, an agriculturist and forester of great and long standing experience, details in this volume his valuable knowledge on the cultivation of the resinous-wood-producing trees (firs, *Abies*) as the only and best means of bringing into cultivable state arid sandy soils such as are known in France under the designation of *landes* and *bruyères*.

February 15, 1872.

The contents of this number are entirely devoted to abstracts from the *Comptes Rendus*.

Bulletin de l'Academie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, No 1, 1872.

In addition to several mineralogical and palæontological papers more especially relating to Belgium, this number contains the following memoir bearing on chemistry:—

Derivatives by Addition to Itaconic Acid and its Isomers.—Dr. T. Swarts.—From the introduction to this lengthy essay we learn that as yet its author does not consider his investigation complete, but, since some papers on this same subject have been published recording investigations made by others, this portion of the author's labours are now published. We regret that the contents of this essay are, notwithstanding its very high intrinsic merits, not suited for useful abstraction, but we quote the headings of the different sections:—Action of chlorine upon citraconic acid; action of chlorine upon itaconic acid; action of heat upon bibromated itapyrotartaric acid; monobromated itaconic acid; monochlorated itaconic acid; aconic acid.

NOTES AND QUERIES.

Phosphates of Lime.—Can you assist me in answering the following queries I have received from France? 1. What are the usages of the trade (I presume they mean in what manner is this commodity sold). 2. What is the proportion usually required of tribasic phosphate of lime? 3. Would phosphates of lime, averaging 43 to 45 per cent tribasic, find a ready market for England? 4. What is the price which might be obtained for such phosphates delivered on the Quai at Boulogne?—R.R.

Pearl-Hardening—Selenite.—(Reply to "Thomas Manning.")—Pearl-hardening is artificially prepared sulphate of lime made for the purpose of being used by paper-makers in many parts of England; this article is preferred on account of being very readily kept in suspension along with the paper pulp and also for its softness. There is plenty of the various native kinds of gypsum in the United Kingdom; it would be as the proverb has it—"carrying coals to Newcastle" to bring from the United States selenite or any similar mineral to this country.

MEETINGS FOR THE WEEK.

Monday, March 11th.—Medical, 8.
—— Royal Geographical, 8.30.
—— London Institution, 4. Prof. John Ella, "On Elementary Music."
Tuesday, 12th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Photographic, 8.
Wednesday, 13th.—Society of Arts, 8.
—— London Institution, 7. Conversazione. Capt. R. F. Burton, F.R.G.S., "Gleanings in Syria and Palestine."
Thursday, 14th.—Royal, 8.30.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
—— Royal Society Club, 6.
Friday, 15th.—Royal Institution, 9. Mr. J. Evans, "On the Alphabet and its Origin."
Saturday, 16th.—Royal Institution, 3. Mr. Moncure Conway, "On Demonology."

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THE CHEMICAL NEWS.

Vol. XXV. No. 642.

ON SOME DERIVATIVES OF URAMIDOBENZOIC ACID.*

By P. GRIESS, F.R.S.

(Concluded from p. 110).

Decomposition of the Isomeric Dinitro-uramidobenzoic Acids on Boiling their Aqueous Solution.

All three of the dinitro-acids are decomposed when their aqueous solutions are boiled for a considerable time, gas being evolved and new acids formed, which have the composition $C_7H_6N_2O_4$. These three new acids, from their formula and properties, may be regarded as isomeric mononitro-derivatives of amido-benzoic acid—

$$C_7H_6N_2O_4 = C_7H_4(NO_2)(NH_2)O_2,$$

their method of formation being expressed in the following manner:—

$$\underbrace{C_8H_6N_4O_7}_{\text{Isomeric dinitro-uramidobenzoic acids.}} = \underbrace{C_7H_6N_2O_4}_{\text{Isomeric nitro-amidobenzoic acids.}} + \underbrace{CO_2}_{\text{Carbonic acid.}} + \underbrace{N_2O}_{\text{Nitrous oxide.}}$$

The acid obtained in this manner from α dinitro-uramidobenzoic acid. which I have called *α nitro-amidobenzoic acid*, crystallises in yellow needles or prisms, which are only slightly soluble in cold water and rather difficultly so in hot; they dissolve readily in hot alcohol, but scarcely at all in ether. The barium salt forms yellowish-red needles, which are very readily soluble in water even in the cold. Dried between filter-paper they were found to have the composition $(C_7H_5N_2O_4)_2,Ba+3H_2O$.

β Nitro-amidobenzoic acid is the name by which I have designated the acid obtained from β dinitro-uramidobenzoic acid by the above-mentioned reaction. It is only very slightly soluble in hot water, but rather easily so in boiling alcohol, from which it crystallises on cooling in clusters of yellowish-red glistening needles or small plates. The dry acid, when gently heated, sublimes, without melting, in shining rhombic plates. Its barium salt forms bright yellowish-red prisms, often well defined, which are only slightly soluble even in boiling water. Dried between filter-paper they have the composition $(C_7H_5N_2O_4)_2,Ba+2H_2O$, the water of crystallisation not being entirely expelled below 190° C.

The γ nitro-amidobenzoic acid obtained from the γ dinitro-uramidobenzoic acid, by boiling its aqueous solution, is easily distinguished from its two before-mentioned isomerides, in being very readily soluble not only in hot water, but also in alcohol and ether, even in the cold. It crystallises in yellow prisms, which melt when heated to a brownish oil; at a higher temperature it decomposes with slight explosion and evolution of yellowish vapours. Its barium salt forms reddish-yellow needles, which are very easily soluble even in cold water, and when dried between folds of bibulous paper have the composition $(C_7H_5N_2O_4)_2,Ba+7H_2O$.

Action of Tin and Hydrochloric Acid on the Isomeric Nitro-amidobenzoic Acids.

If the isomeric nitro-amidobenzoic acids are gently warmed with tin and hydrochloric acids, they are reduced to the corresponding diamido-acids in the following manner:—

$$\underbrace{C_7H_4(NO_2)(NH_2)O_2+H_6}_{\left.\begin{matrix}\alpha\\ \beta\\ \gamma\end{matrix}\right\}\text{Nitro-amidobenzoic acids.}} = \underbrace{C_7H_4(NH_2)_2O_2+2H_2O.}_{\left.\begin{matrix}\alpha\\ \beta\\ \gamma\end{matrix}\right\}\text{Diamidobenzoic acids.}}$$

These diamido-acids are separated from the tin chloride formed at the same time by the ordinary methods.

α Diamidobenzoic acid, $C_7H_4(NH_2)_2O_2$, crystallises from its solution in boiling water, in which it is sparingly soluble, in minute but well-defined short prisms, which have a greyish tinge. It is remarkable for the extremely sparing solubility of its sulphate, $C_7H_8N_2O_2,SH_2O_4$, a compound crystallising in white needles.

β Diamidobenzoic acid crystallises in pale yellow-coloured plates, which are very difficultly soluble in cold water, but rather readily so when it is hot. Its sulphate has the formula $(C_7H_4(NH_2)_2O_2)_2,SH_2O_4$, and is very sparingly soluble in hot water, although not so much as is the corresponding salt of the acid just described. It is almost entirely deposited on cooling in white, soft, shining, almost oval-shaped plates.

γ Diamidobenzoic acid crystallises in long yellowish-white needles, whose solubility closely resembles that of the two other isomeric acids. Its sulphate forms white six-sided tables or prisms, which, when dried in the air, have the composition $(C_7H_8N_2O_2)_2,SH_2O_4+1\frac{1}{2}H_2O$; they are almost as insoluble as the corresponding compound of the α diamido-acid. When the solution of γ diamidobenzoic acid in dilute hydrochloric acid is decomposed by ferric chloride, a brownish-red semi-crystalline precipitate is obtained, consisting of a new acid, which, however, I have not at present more closely investigated.

Action of Nitrous Acid on the Isomeric Diamidobenzoic Acids.

In this reaction a remarkable difference is observed between the α diamidobenzoic acid on the one hand, and β and γ diamidobenzoic acids on the other. When α diamidobenzoic acid is treated with a quantity of warm and moderately dilute hydrochloric acid, insufficient to dissolve the whole, and on cooling the filtered solution is mixed with one of sodium nitrite, a semi-solid mass of crystals is formed. These after separation of the mother-liquor are easily purified by crystallisation from hot water, with the addition of a small quantity of animal charcoal. The compound thus obtained forms long needles or small plates, which, heated in a dry state, explode. It is rather easily soluble in hot water; by long boiling it gradually decomposes, giving rise to a brown insoluble amorphous precipitate. Curiously enough it does not possess acid properties, being insoluble both in ammonia and potassa, whilst, on the contrary, it combines with the mineral acids, forming well-crystallised salts. Its hydrochlorate forms six-sided plates, which are readily soluble. Unfortunately I have not yet been able to establish the composition of this basic compound with certainty, although from a determination of the gold in its gold salt, which crystallises in dark yellow needles, I believe it to have the composition indicated by the formula $C_{14}H_{13}N_5O_4$. Its formation, therefore, would take place in the following manner:—

$$\underbrace{2(C_7H_8N_2O_4)}_{\alpha\ \text{Diamidobenzoic acid.}} + \underbrace{NHO_2}_{\text{Nitrous acid.}} = \underbrace{C_{14}H_{13}N_5O_4}_{\text{New compound.}} + \underbrace{H_2O.}_{\text{Water.}}$$

It is necessary to mention that this basic compound is not formed when sodium nitrite acts upon α diamidobenzoic acid in the presence of free hydrochloric acid, instead of in the manner just described. In this case a brisk evolution of nitrogen takes place, and after some time the yellow solution deposits an amorphous reddish-brown acid.

As regards the behaviour of the two other isomeric diamidobenzoic acids under the circumstances previously mentioned, this is quite different to that of the α diamidobenzoic acid. When their solution in dilute hydrochloric acid is acted upon by sodium nitrate, a white crystalline azo-acid immediately separates, and that whether the hydrochloric acid is in excess or not. The azo-acid thus obtained from the β diamidobenzoic acid crystallises in

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* A paper read before the Royal Society.

short needles, which are very difficultly soluble in hot water, and scarcely at all in cold. When heated in a dry state it melts and blackens, a small portion subliming, whilst the greater part is decomposed, leaving behind a difficultly combustible carbonaceous residue. The composition of this azo-acid corresponds to the formula $C_7H_5N_3O_2$. Its barium salt has the composition $(C_7H_4N_3O_2)_2,Ba+4H_2O$, and crystallises in very slender colourless needles, which dissolve readily in hot water, but only sparingly so in cold.

The azo-acid prepared from the γ diamidobenzoic acid, although isomeric with that just described, differs considerably from it, crystallising in long hair-like silky needles, which on drying, shrink together to a felt-like mass. It is rather more easily soluble in hot water than the corresponding α acid, and when gently heated melts to a yellow oil, partial sublimation taking place at the same time; at a higher temperature it decomposes with slight explosion. Its barium salt crystallises in white needles, which are rather difficultly soluble in hot water, and very sparingly so in cold. Its composition is expressed by the formula $(C_7H_4N_3O_2)_2Ba+2H_2O$.

The formation of these two azo-acids may be thus expressed:—

$$\underbrace{C_7H_8N_2O_2}_{\left.\begin{matrix}\beta\\\gamma\end{matrix}\right\}\text{Diamidobenzoic acids.}} + \underbrace{NHO_2}_{\text{Nitrous acid.}} = \underbrace{C_7H_5N_3O_2}_{\left.\begin{matrix}\beta\\\gamma\end{matrix}\right\}\text{Azo-acids.}} + \underbrace{H_2O.}_{\text{Water.}}$$

I may add that both these acids contain water of crystallisation, which is expelled at 100° C., and at the same time call attention to their great stability, in which respect they differ very remarkably from most other azo-compounds. Finally, I would remark that three other compounds, having the same formula as these azo-acids, are already known, to which I gave the names diazobenzimide, diazodracylimide, and diazosalylimide.* They were obtained by the action of ammonia on the perbromides of the corresponding diazo-acids, as shown in the equation—

$$\underbrace{C_7H_4N_2O_2,HBr,Br_2}_{\text{Perbromides of....}\left\{\begin{matrix}\text{diazobenzoic acid,}\\\text{diazodracylic acid,}\\\text{diazosalylic acid.}\end{matrix}\right.} + \underbrace{4NH_3}_{\text{Ammonia.}} =$$

$$= \underbrace{\left.\begin{matrix}(C_7H_4N_2O_2)''\\H\end{matrix}\right\}N}_{\begin{matrix}\text{Diazobenzimide,}\\\text{Diazodracylimide,}\\\text{Diazosalylimide.}\end{matrix}} + \underbrace{3NH_4Br.}_{\text{Ammonium bromide.}}$$

These bodies also form saline compounds with metals, but in their reactions, as well as in other respects, differ entirely from the azo-acids just described, rendering it certain that they have a different constitution from them.

Decomposition of the Isomeric Diamidobenzoic Acids at a high Temperature.

When either of the diamidobenzoic acids is submitted to dry distillation in a retort, it splits up into carbonic acid, which is evolved, and a yellow oil, which crystallises in the neck of the retort, thus:—

$$C_7H_8N_2O_2 = C_6H_8N_2 + CO_2.$$

The compound $C_6H_8N_2$, obtained in this manner from the α diamidobenzoic acid, is moderately soluble in hot water, and crystallises therefrom in reddish-coloured scales, melting at 140° C. It exhibits the character of a base, and forms crystalline salts with the mineral acids. It can readily be seen that the composition of this base is the same as that of the phenylen diamides described by Dr. Hofmann,† $C_6H_8N_2 = C_6H_4(NH_2)_2$; and its properties leave no doubt that it is identical with one of the latter, namely that formed by the action of reducing agents on the nitraniline prepared from substituted anilides.

The compound $C_6H_8N_2$, obtained by the dry distillation of β diamidobenzoic acid, differs not only from the base just described, but also from the phenylen diamine which Dr. Hofmann obtained by the reduction of dinitrobenzol. It is easily soluble in hot water, and crystallises therefrom in white rectangular four-sided tables or plates, which usually have a reddish tinge. It melts at 99° C., and boils at about 252° C. It is likewise possessed of basic properties, and must be regarded as a new isomeric modification of phenylen diamine. The sulphate of this base crystallises in pearly scales, the composition of which corresponds to the formula $C_6H_4(NH_2)_2,SH_2O_4+1\frac{1}{2}H_2O$, and which readily part with their water of crystallisation at a temperature a little above 100° C. Its platinum salt is precipitated in the form of brownish-red needles. When ferric chloride is added to a solution of this base in hydrochloric acid, ruby-red needles immediately form, consisting of the hydrochlorate of a new base. In a free state the latter forms bright yellow microscopic needles, which are almost insoluble in all neutral solvents. I have reason to believe that it has the formula $C_{12}H_{10}N_4$, and that its method of formation is as follows:—

$$\underbrace{2(C_6H_8N_2)}_{\text{New phenylen diamine.}} + O_3 = \underbrace{C_{12}H_{10}N_4}_{\text{New base.}} + \underbrace{3H_2O.}_{\text{Water.}}$$

As one or other of the phenylen diamides just mentioned is obtained when the α or β diamidobenzoic acid is submitted to dry distillation, I fully expected that the γ diamidobenzoic acid, under the same circumstances, would give rise to a third phenylen diamine, and that this would be identical with that derived from dinitrobenzol. Strange to say, this is not the case, the phenylen diamine obtained by the dry distillation of γ diamidobenzoic acid being precisely the same as that produced in the same way from β diamidobenzoic acid.

The subjoined Table shows the characteristic difference that exists between the melting-points and boiling-points of the three isomeric phenylen diamines at present known:—

	Fusing-point.	Boiling-point.
Phenylen diamine from nitro-acetanilid and from α diamido-benzoic acid	140°	267°
Phenylen diamine from β and γ diamidobenzoic acids ..	99°	252°
Phenylen diamine from dinitrobenzol.	63°	287°

Besides the three isomeric diamidobenzoic acids which I have described in the course of this paper, a fourth acid exists, having the same composition, namely, the diamidobenzoic acid obtained by Dr. Voit* by reducing ordinary dinitrobenzoic acid with sulphuretted hydrogen, and which I have since further investigated.† I propose, at present, to retain for this the simple name diamidobenzoic acid. It is distinguished from the other diamidobenzoic acids, not only by its physical properties, but especially in not yielding a volatile organic base when submitted to dry distillation, becoming, on the contrary, completely carbonised with simultaneous evolution of ammonia. With nitrous acid also it behaves quite differently, being converted into an insoluble amorphous acid of a reddish-brown colour.

When it is considered that each of the four diamidobenzoic acids at present known are derived, at least in a certain sense, from ordinary α amidobenzoic acid, there is reason to suppose that each of the acids which are isomeric with amidobenzoic acid, namely, amidodracylic and anthranilic acid, would, under favourable circumstances, give rise to four new diamido-acids, so that it is obvious that at least twelve isomeric diamidobenzoic acids may be conceived to exist.

In the preceding notice I have confined myself to the consideration of some of the most important chemical and physical properties of the substances described; but I hope to be able to lay before the Society at a future time some account of their rational constitution and of the causes which produce the various isomerisms.

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* *Zeitschr. f. Chem.*, 1867, p. 164.

† *Proceedings of the Royal Society*, vol. xii., p. 639.

* *Ann. d. Chem. u. Pharm.*, vol. xcix., p. 100.

† *Ibid.*, vol. cxxviii.

ON A NEW HYGROMETER.*

By WILDMAN O. WHITEHOUSE.

The use of Mason's wet-bulb thermometer as a means of hygrometric measurement, though it be admitted to be the most practically useful, and indeed the only recording instrument for the purpose, has yet this serious inconvenience, not to say defect, viz., that its indications either cease or are valueless at temperatures below 32° F.

In a conversation which the writer had with the Director of the Meteorological Office some months ago, the question arose whether anything could be suggested to remedy this inconvenience.

It was obviously inadmissible to substitute any other fluid for, or to make any addition to, the water employed for the wet bulb, as then it would cease to be a test for the purely hygrometric capacity of the air. It became therefore necessary to fall back in another direction, and to find some hygrometric body which should readily and rapidly absorb moisture from the air, and at the same time afford some means of measuring and recording the amount of such absorption.

Fused chloride of zinc or of calcium seemed promising as very active agents, absorbing rapidly on their surface, and allowing the readiest possible escape of the fluid hydrate for measurement, yet no means presented itself either of accurately measuring, regulating, or maintaining the exact extent of surface exposed for absorption; nor could the substance itself be easily renewed when required, nor, indeed, could either of these substances be regarded as wholly free from the interference of frost, as the moisture absorbed from the atmosphere at a temperature much below freezing-point may remain frozen on the surface, and become incapable of continuous measurement. It seemed essential to the accuracy and practical utility of any instrument designed for this purpose—

(1). That a fixed and invariable extent of surface should at all times be exposed for absorption of moisture.

(2). That the apparatus should be simple, inexpensive, and not inconvenient in use.

(3). That the hygrometric substance should be continuously and steadily renewable; and above all, if it were possible,

(4). That the measurement should be effected thermometrically.

No solid hygrometric substance seemed capable of meeting these requirements; but all the conditions seemed likely to be fulfilled by the use of concentrated sulphuric acid. This would admit of being spread in an exquisitely fine film over the surface of the bulb of a thermometer by means of a glass capillary syphon, of which one end should rest on the upper part of the bulb, while the other end dipped into a reservoir of the acid. A continuous supply could be maintained for any required length of time by suitable arrangements. The absorption of moisture would necessarily be attended by a rise in temperature, and this would be proportioned to the amount of hygrometric moisture absorbed; while the hydrated acid, having fulfilled its office, would fall in drops from the bulb into any tube or reservoir placed for the purpose.

An instrument has been constructed by the writer to test this principle, which has, by the courtesy of the Director of the Meteorological Office, been under observation for some weeks.

It consists essentially of three thermometers of similar construction, and used as a "wet bulb," a "dry bulb," and an "acid bulb," respectively placed side by side on a suitable frame, and read together for comparison.

The experience already gained in the use of this instrument has shown that, with a reservoir of proper construction, the supply of acid may be made continuous for any required length of time, and that, from the very slight variations of flow which occur in its action, the supply to the thermometer will be sensibly equable.

The length of the syphon, and the size of the capillary bore, together with the difference of level between the surface of the fluid in the trough of the reservoir, and the point of delivery on the bulb, will determine the rate of supply of the acid.

It is clear that either a too rapid and continuous stream of acid at the temperature of the air, or a too scanty supply, would diminish the readings; yet it is found that practically there may be a pretty wide range of variation in the supply of acid, within which no essential change in the sensibility of the instrument is noticed.

For a bulb having 1 square inch of surface one drop per minute is sufficient, though the time may range from 40 to 100 seconds without inconvenience, the time being noted, as the hydrated acid, after having fulfilled its office, falls drop by drop from the bulb.

The quantity of acid required at this rate is about 3 fluid ozs. per diem, or one imperial pint per week, which is procurable of uniform density, sufficiently pure and free from lead, at a cost of about 2½d.

The temperature of the acid in the reservoir is of course that of the surrounding air; the elevation of temperature shown by the acid-bulb thermometer is due to, and seems to be strictly a measure of, the amount of moisture absorbed by the film of acid spread on the surface of the bulb, say 1 square inch, continuously supplied in its concentrated state, and as constantly passing off hydrated.

While, therefore, this instrument is, like Mason's, intended to measure the amount of hygrometric moisture in the air, and to do so thermometrically, it yet is, in its principle and in its operation, essentially of an opposite character.

The ordinary wet-bulb thermometer is at the zero of its scale in an atmosphere of perfect saturation, and its action depends upon the amount of sensible heat absorbed and rendered latent by evaporation of the water from its surface.

The acid-bulb thermometer is at its zero in a perfectly dry atmosphere, and its action depends upon the amount of latent heat rendered sensible by the condensation of vapour into water on the surface of the bulb, and by the combination of this water with the concentrated acid.

It would appear that an hygrometer on this principle is entirely free from the action of frost; while its sensibility is so great as to be at first almost embarrassing.

This may, however, be easily regulated and toned down, if necessary, to any required range by the dilution of the acid with glycerine, a fluid which is also of itself hygrometric, though its thermal effects are far less marked than those of sulphuric acid.

It will require a most careful series of observations to elicit all the points noteworthy in the new instrument, and to determine the relative values of the wet- and acid-bulb readings, noting the behaviour of each at every part of the scale, from absolute dryness to saturation, and at temperatures ranging from 75° or 80° down to 0°.

This will be necessary before the instrument can aspire to take its place among the recognised standards of meteorological science; but in the meantime the writer has been advised to offer, at the earliest time, a brief description of it to the notice of the Royal Society.

ESTIMATION OF NITROUS ACID.

By GEORGE E. DAVIS.

As "Discipulus" has addressed a query to me on page 95 of this present volume, upon the above subject, and does not state any particular process, I suppose he wishes me to give that which is thought the best. This would be difficult to do, as each operator would advocate the use of his own system; but I will give the results of my later experiments so that the reader can form his own ideas upon the subject.

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* Read before the Royal Society.

The Chloride of Lime Process.

Standard Solution of Calcium Chloroxide.—Dilute bleaching liquor of 28° T., so that 10 c.c. contain 0·7 grm. of chlorine. This solution, if kept well-stoppered and not exposed much to the light, will keep for a long period. It should be made in quantities of 500 c.c. or a litre at a time according to the quantity used.

Indicator.—This is a strong aqueous solution of indigo sulphate.

The Process.—Take a white glass-stoppered bottle of 1500 c.c. capacity, and place therein a litre of distilled water. Add 10 c.c. of the standard solution of calcium chloroxide, and pour in the nitrous vitriol, well agitating after each addition, until the odour of chlorine is very faint; when this point is reached the acid is to be very cautiously added, a few drops at a time, until a blue colour is obtained with the indigo sulphate solution. The number of divisions of the nitrous vitriol taken and divided into 100 gives the percentage of N_2O_3, *disregarding the sp. gr. of the acid*; if, therefore, the true percentage is required the quotient must be divided by the sp. gr.

The burette I employ is Binks's form; it contains 37·4 c.c. graduated into 100 parts, commencing at the top and ending with 100 at the bottom. Binks's form is not a very delicate one to use for most purposes, but it seems admirably suited to this process, for the adhesion of strong vitriol to glass is very great, so that it is very easy to regulate the supply of acid to single drops. The tube should be allowed to stand a few minutes before reading off in order that the vitriol which adheres to the sides of the tube may descend and a correct reading be obtained.

An estimation by this method occupies less than three minutes, and is so simple that any intelligent workman may use it. In four different samples the following divisions of the burette were used:—68, 57, 84, 67, which would be equal to—

$$\tfrac{100}{68} = 1{\cdot}47\,;\ \tfrac{100}{57} = 1{\cdot}754\,;\ \tfrac{100}{84} = 1{\cdot}190\,;\ \tfrac{100}{67} = 1{\cdot}492$$

on the volume.

The α Permanganate Process.

Standard Solution of Potassium Permanganate.—Dissolve 3·163 grms. of pure potassium permanganate crystals in a litre of water. Its accuracy may be tested by weighing off 0·63 grm. of pure oxalic acid crystals, dissolving in water and adding dilute sulphuric acid, this should decolourise exactly 100 c.c. of the permanganate solution.

I have stated before that the permanganate is not immediately decolourised on its addition to a very dilute aqueous solution of nitrous acid: I ventured a part explanation which I think has a small influence upon the results, but very small, as I have found by experiment that when the nitrous vitriol is added to a very large quantity of water, that nearly the whole of the N_2O_3 exists in solution as such, even when the temperature of the water has been raised to 80° C. I have also found that the decolouration of the permanganate takes place very rapidly when the temperature of the water is raised to about 80° C., and as there is no loss of gas by mixing with the water, this process answers well where there are only traces of nitrous acid in the vitriol, or from 0·08 to 0·2 per cent by weight.

This process has also the advantage that the number of c.c. of permanganate used indicates the percentage of N_2O_3 by weight without any calculation, and as now modified is a rapid process, occupying only four minutes for its completion; the permanganate is its own indicator and it is not an expensive process.

The Process.—Weigh off accurately 1·9 grms. of the nitrous vitriol, quickly dilute with 700 c.c. of water, heat to about 70° or 80° C., and add the permanganate until a permanent rose-colour is obtained; the decimal place being then removed one place to the left gives the percentage of N_2O_3 by weight thus:—

1·9 grms. of nitrous vitriol, treated as above, required 8·85 c.c. of permanganate; this would be equivalent to 0·885 per cent of N_2O_3, and, being multiplied by the sp. gr., gives 1·540 on the volume, a system so often used in chemical manufactories.

In order to avoid weighing, 10 c.c. of the same sample of vitriol were introduced into the bottom of a flask of water at 80° C. (contents 700 c.c.), and permanganate added. 81·6 c.c. were required, which, multiplied by 0·019, gives 1·550 per cent, or, more correctly, 1·55 grms. in 100 c.c. of the nitrous vitriol. The water used for this experiment should be slightly coloured with permanganate before the vitriol is added, and the burette I prefer is Gay-Lussac's.

The β Permanganate Process.

The same permanganate solution is used as in the last process.

Take a flask of 700 c.c. capacity, containing 400 c.c. of water, heat to about 90° C., and add 100 c.c. of the standard permanganate solution; heat again, and add the nitrous vitriol from a burette until one drop takes the rose tint from the solution. The number of divisions used, divided into 100, gives the volumetric percentage of N_2O_3; I use a Binks burette also for this process; it contains 19 c.c. divided into 100 parts.

I have stated that higher results may be obtained by this process the longer the operation is delayed; this was in operating with cold solutions. When the solution of permanganate is heated to 80° C. the operation is quickly ended, and numbers are obtained which are nearly identical with the chloride of lime process, but rather higher.

The following are the results of the three processes as they now stand. For some time back I have daily used these processes side by side, and the results are very regular.

	Chloride of Lime.	α Permanganate.	β Permanganate.
1.	1·538	1·482	1·545
2.	1·562	1·496	1·567
3.	1·470	1·382	1·470
4.	1·745	1·702	1·773
5.	1·488	1·413	1·492
6.	1·190	1·113	1·204
7.	2·174	2·147	2·193

The chloride of lime process now comes slightly below the β permanganate; this is owing to the small portion of the chlorine being retained in the stoppered bottle which used to escape when the open flask was used.

"Discipulus" asks whether I have compared these processes with the Urea method? and by that I suppose he means Hart's method and Crowder's method. I have compared them, but with no definite result.

Hart's process I cannot manage at all. The following results were obtained by acting upon urea nitrate at a boiling heat with the nitrous vitriol, as recommended by Muspratt:—

Hart's method.		β Permanganate.
1st.	2nd.	
3·14	2·26	1·784
2·14	1·98	1·033

Two different trials have never, with me, come out identical when operating upon the same sample, which *prima facic* appears to be sufficient proof of its incorrectness, for when operating upon the same sample we should expect, *cæteris paribus*, to arrive at least at the same result.

I have compared the processes also with Crowder's process, but this comparison has not been satisfactory; for this process indicates nearly twice as much N_2O_3 as appears on testing with permanganate or chloride of lime. Which process is at fault I cannot say at present, but I suspect the *nitrate* of urea of not giving accurate results, and although it may depend upon a reaction "which is perfectly definite and constant," as stated by Mr. Crowder, yet the cause of this difference ought to be perfectly understood. It is a problem which I have set myself to solve whenever I have an opportunity of performing the experiments.

There are several objections to this latter process which tend to make it a slow one; it necessitates three weighings. The apparatus after being heated is allowed to cool, which operation takes time, and the expense of urea nitrate is another drawback.

Radcliffe Chemical Works,
March 2, 1872.

NOTES ON THE

PRESENCE IN CERTAIN FIBRES OF A SUBSTANCE SUSCEPTIBLE OF SOME STRIKING COLORIFIC CHANGES WHEN CHEMICALLY TREATED.*

By WILLIAM SKEY,
Government Analyst, New Zealand.

In attempting to bleach some samples of fibre of *Phormium tenax* with chlorine, I experienced such difficulty that I was led to investigate into the cause, when certain reactions manifested themselves which I think proper to communicate at once, as they show that there exists in certain fibres a substance which, as far as I can learn, has not yet been described in chemical works, and from the deportment of which, with certain reagents, we are able easily to discriminate those fibres which contain it from those in which it is not present.

The results arrived at up to the present time are as follows :—

(1). That a number of fibres (that of *Phormium tenax* included), when allowed contact with chlorine, hypochlorous, or chromic acid, acquire a pale yellow colour, which is changed to a beautiful rose-red, when the fibres are afterwards treated with alkalies, alkaline carbonates, or earthy carbonates; while acids restore the yellow tint when applied to the reddened fibres.

(2). That the alkaline manganates affect these fibres in the same manner as chlorine, &c., except that they are blackened by a deposit of oxide of manganese, which, when removed by the proper acids, leaves the fibre of a yellow colour, subject to the same colouration by contact with alkalies as in the above experiment (No. 1).

(3). That these fibres are coloured a pale yellow by alkalies and their carbonates, but, in the case of these last, the colour is paler than with the alkalies.

(4). That by cold strong nitric acid they are coloured red-brown, which changes to a yellow tint on contact with alkalies.

(5). That slightly diluted cold sulphuric acid renders these fibres quite yellow; while the concentrated acid blackens them at common temperatures.

(6). That, when treated for a long period with chlorine, hot chromic or nitric acids, these fibres are completely whitened, but deteriorated in strength. The addition of ammonia or sulphuric acid has, then, no colouring effect on them.

(7). That *Phormium tenax* exhibits the same reactions with these several reagents, and in as great a degree when previously digested for two hours in boiling ether, alcohol, or chloroform, or for eighteen hours in boiling water, or when soaked in cold water for eight days.

(8). That *Phormium tenax* fibre cut up into lengths of one-eighth of an inch, and digested for twelve hours in boiling water, exhibits as well marked reactions to chlorine in conjunction with ammonia, or to sulphuric acid, as it did before such treatment.

In the annexed columns, the effects of ammonia on the oxidised fibres of certain plants in relation to these changes of colour are stated :—

Coloured Rose-Pink.	Coloured Brown.	Unaltered.
Phormium tenax.	Wood.	Hemp.
Yucca.	*Manilla*, impure.	Sunn hemp.
Sisal.	,, pure (?).	*Rheea.*
Aloe.		Raw cotton.
		Linum.

A great number of samples of *Phormium tenax* have been experimented with, the results being always similar; among these have been—

(1). Those prepared by machinery only.

(2). Those prepared by a short retting process and machined afterwards.

(3). Those prepared by Maoris—the cleanest I could obtain.

(4). Some prepared by myself and which had never been dry, and some of them which had been steeped in water five days.

In respect to the flax (*Linum*) used, it had no appearance of being bleached, but only retted, and I am anxious to learn whether the fresh fibre of this plant would behave to these tests the same as that of the *Phormium tenax*.

This, together with a great many other points, will require time to enable me to determine. It would be desirable, for instance, to know if long-continued retting would remove or change the principle on which the colouration of the fibre depends, and also the effect of sunlight; also, whether the principle is as abundant in the fibre at one season of the year as at another, and if it is equally dispersed through the several varieties and parts of the leaf.

It is premature as yet to enter fully upon the deductions which these results would lead to, but I think the following points are clearly established :—

(1). That certain fibres, among which is *Phormium tenax*, contain a substance quite distinct from the fibre, though such fibres have been prepared with the greatest care, and appear to be quite pure.

(2). That this substance is insoluble in hot or cold water, also in alcohol, ether, and chloroform, and in aqueous solution of hydrochloric acid.

(3). That a small portion of it is on the outside of the fibre, as shown by the carbonate of lime test.

(4). That the whole of this substance is probably in chemical combination with the fibre.

(5). That it cannot be removed chemically without injuring the fibre, as even pure fibre (cellulose), which does not contain this principle, is weakened considerably when passed through these processes.

In reference to the nature of this principle it is difficult to conjecture, as it clings so persistently to the fibre as to appear inseparable, except in an altered state.

From the blackening of the fibres containing it by sulphuric acid, I infer that it is non-nitrogenous—probably it is allied to some of the colouring principles of madder.

When oxidised by chlorine, &c., it has the colour of fresh turmeric paper, which paper is, like this, reddened by contact with alkalies.

In conclusion, I may observe that this substance is not unlikely to be the basis of the yellow and red colour of the *Phormium tenax* and other plants, and that while it may not be necessary to remove it from these fibres for many purposes to which they may be applied, it is questionable whether we can have them of a pure unalterable white colour without its removal.

Further Notes.

(1). The fresh fibre digested for twenty-four hours in a weak solution of caustic potash, is whitened in those portions of it which have freest access to the liquid, that is, the ends and outside portions; and such portions do not then give any reaction with ammonia after contact with oxidising agents.

(2). That prolonged contact with cold hypochlorous acid also renders such parts colourless, or nearly so, and that ammonia has then no effect upon such fibres.

(3). That, by stopping the second process when the

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* Read before the Wellington Philosophical Society, August 26th, 1871.

fibre is thus divested of the principle giving the reactions before described, such fibre does not appear to be greatly weakened, whether it is tested dry or wet.

(4). That, in the case of the first experiment, the fibre is more weakened than in the second, but still not so much that the fibre appears very easily or readily detached into ultimate ones.

Deductions.

Taking all these results into consideration, I do not see that they tend as a whole to establish any theory which may be brought forward that regards the principle thus indicated as a cement.

It is certainly a very definite principle; but the functions it may or does perform in the growing plant we have yet to learn.

I may state that I have not found it with certainty away from the fibres, while it seems a constant associate of them in their natural, or at least in their green, state.

Action of Alkalies on the Fibre.

Portions of different kinds of *Phormium* fibre, and also of Manilla hemp, were submitted to the action of a strong solution of caustic potash, and kept at the boiling-point for four hours.

The result was in every case the same, as has been described by Captain Hutton, the fibre being reduced to a soft pulp, like the "half-stuff" of paper manufacturers, in which the ultimate fibres are perfectly non-coherent so long as the mass remains wet, but when dried possessing a considerable amount of tenacity. This is rendered very obvious by the behaviour of an untwisted thread of the fibre thus prepared, which will bear a strain of several pounds when dry, but immediately on touching any portion of it with a drop of water will not bear as many grains.

This experiment was varied in several ways, care being taken to remove the last trace of the alkali from the fibre by treatment with dilute acid and subsequent washing, which had the effect of making the fibre extremely soft, silky, and white, but without in the least depriving it of the above singular property. Alcohol, ether, oil, and other non-hydrating fluids were substituted for the water, but were found not to reduce the cohesion of the ultimate fibres. When examined under the microscope in the dry state, the prepared fibre is found to consist of shrivelled and collapsed ultimate fibres, twisted and matted together; but, on the addition of water, they are easily observed to become distended and separated from one another, acquiring, at the same time, a well-defined smooth outline. The form of the ultimate fibre itself is not much affected, nor does it appear to be in any degree weakened by the action of the potash, as broken cells are rarely seen, even when the dry fibre is parted with some violence; while in the wet state the ultimate fibres can be separated for examination with great facility.

The action of the alkali, therefore, appears to be that of altering, and probably thinning the cell wall, so as to render it capable of absorbing water with rapidity. The fact that the *Phormium* fibre can be reduced by a single process to the "half-stuff" of the paper-maker, but having the very unusual property of being composed of complete fibre cells, having an equal length of about half an inch, and at the same time possessing a pure colour and glossy lustre, may perhaps lead to the introduction of a totally new class of manufactures, by which a material will be obtained with even greater facility than ordinary paper of fine quality, and at the same time possessing an even texture, cohesive strength, and "body."

After the proper form is given to the fibre, by taking advantage of its gelatinous condition when wet, there would be no difficulty in drying it in contact with such a material as would prevent the fibres again absorbing water.

Action of Acids.

When a mineral acid was substituted for the alkaline solutions, in experiments similar to the preceding, the fibre exhibited a totally different result, becoming feeble, harsh, and under the microscope showing that the fibre cells were weakened, as, whether broken wet or dry, the ultimate fibres themselves invariably snapped across and presented broken ends. The effect of the application of chlorine, as in the ordinary bleaching process, was the same as that of the acids, but to a less degree.

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

XIV.

The spectroscope is one of the happiest discoveries of modern science. It has enabled the chemist to differentiate apparently identical bodies in the organic world, and has also opened to him the knowledge of the constituent elements of many of the heavenly bodies. In the animal world its application is without parallel, so great are the advantages accruing from its use.

It will be necessary to mention, before proceeding to the instrument itself, a few facts concerning light and its properties.

Light is considered to be some disturbing influence acting upon an all-pervading ether, and producing undulations or waves which convey the sensation called light to our retinæ; these waves are not progressive, but may be compared to the motion of a field of standing corn when agitated by a breeze. The known sources of light are the sun, stars, combustion, electricity, and phosphorescence. When vibrations of this ether are capable of being produced in a body, it is said to be transparent; when not so, it is opaque. Opaque bodies either absorb or reflect light. Polished metallic surfaces reflect about 95 per cent of light received; the only instances of total reflection being the third face of a prism and the under surface of a transparent liquid when viewed at the so-called critical angle.

Light undergoes several modifications in passing through transparent bodies, the principal being refraction. In passing from a rare to a dense medium it is refracted, or bent towards the perpendicular; when passing from a dense to a rare medium, the reverse. If a ray of light passes through a transparent body in the form of a prism, not only is the ray bent, but it is dispersed, that is, spread out like a fan, and the band no longer remains white, but consists of red, orange, yellow, green, blue, indigo, and violet, the violet being bent aside the most. This spectrum proves the compound nature of light; if these coloured rays be caught on a lens they become condensed to white light at the focus. If differently coloured glasses be separately interposed between the spectrum and screen, all light will be cut off excepting the rays identical in colour with the glass.

There are three kinds of spectra—the continuous, as developed from the lime-light; the interrupted, when only certain bright lines appear; and the reversed, when in the continuous spectrum black lines are to be seen. This last is typified by the sun. The existence of black lines was discovered by Wollaston; but Fraünhofer, after whom they are named, was the first to map them out.

We saw that certain rays were always visible in one place; thus, if we take a flame incapable of producing a spectrum (a Bunsen), and burn in it some metal, as sodium, which will produce a light, we shall have, not a perfect spectrum, but an interrupted one—that is, bright lines will appear, in this case a yellow one, at definite positions in the field. Each metal having different lines, we are enabled to distinguish them very readily one from another.

The reversed spectrum is produced by the stronger light of the continuous spectrum absorbing the weaker rays of the burning metal or gas; by comparing Fraünhofer's lines with the bright lines produced by incandescent bodies we are enabled to tell the constituents of the sun's atmosphere.

Various bodies have the property of stopping the rays of light, and in this way producing black spaces or bands at different parts of the spectrum; these are called absorption bands.

Blood, chlorophyll, anilines, &c., give decisive spectra, readily recognised again.

Inasmuch as the ordinary spectrum contains heat rays in the red portion, light rays in the yellow, and actinic, or chemical rays, in the blue, so at the extreme violet another kind of ray may be developed by introducing a body, like quinine, capable of fluorescing. This is a complicated phenomenon to us at present, but very little understood; it still has been made very available, and has been partially worked out by Stokes and subsequently by Thudichum.

A very useful, but rough, spectroscope may be made by placing an ordinary bisulphide of carbon prism in a dark box, with a slit in one side to receive the light, and a hole in the other through which to observe the spectrum.

The better instruments are of brass, with condensed glass or quartz prisms and lenses to concentrate the light and magnify the spectrum; by means of a reflecting prism a second spectrum may be thrown on the field.

ON A METHOD OF DEMONSTRATING THE COMBUSTIBILITY OF DIAMOND AND GRAPHITE.

By C. J. WOODWARD, B.Sc.

To show to a class the combustion of a diamond in oxygen is an experiment of great interest and importance, but which to exhibit satisfactorily is a matter of some difficulty, at any rate where a small diamond only is used. The usual method, by heating the diamond in a platinum spoon before the blowpipe and then plunging it into oxygen, requires several heatings, and it is seldom the intense light produced by the combustion is seen for more than a second or two, owing to the cooling action of the metal by conduction, which lowers the temperature of the diamond below its ignition-point. The ingenious arrangement of Faraday's, in which the diamond is placed in a platinum spoon over a jet of burning hydrogen, and the whole lowered into a vessel of oxygen, serves very well; but if the platinum spoon be thin it is liable to be melted, and if thick it cools the diamond too much after the hydrogen is turned off. I have used a cup of pumice-stone placed in a deflagrating spoon for supporting the diamond, and with considerable success; but a recent failure induced me to contrive an arrangement which answers very well indeed. The method will be understood by reference to the accompanying woodcut (Fig. 1). A flask, A, of about a litre capacity is fitted with a caoutchouc stopper. Through the centre of this stopper passes the little arrangement shown in Fig. 2, in which *a b* are two strips of brass insulated from each other by a strip of bone. Each of the lower ends of *a b* terminates in a clamp, *c d*, while the upper ends which project through the stopper are connected with binding screws, E, for attaching to a battery. Between the clamps, *c d*, is stretched a thin strip of platinum foil hollowed in the centre to form a cup to receive the diamond. Besides this arrangement passing through the centre of the stopper, there are also two tubes, B and C; B is connected with a supply of oxygen, and C is connected with the flask D, fitted up like a wash-bottle. To use the apparatus, the diamond is placed in the platinum cup, and the stopper, with its fittings, placed in A. The tube, B, is connected with a bag of oxygen, and C attached to the long tube of the wash-bottle, D, which is half filled with lime-water. The oxygen is allowed to bubble through the lime-water for a few seconds, to show that it will not produce a turbidity. The binding screws, E, are then connected with a sufficiently powerful voltaic battery, when the platinum cup becomes heated and soon the diamond starts into combustion. The carbonic anhydride formed passes into D, and soon reveals its presence by producing a milkiness in the lime-water. Should it be desired to show the combustion of graphite, a little of the powdered mineral is put in the spoon and kept heated by the battery, when in a very short time sufficient carbonic anhydride will be formed to produce a reaction by the lime-water.

Fig. 1.

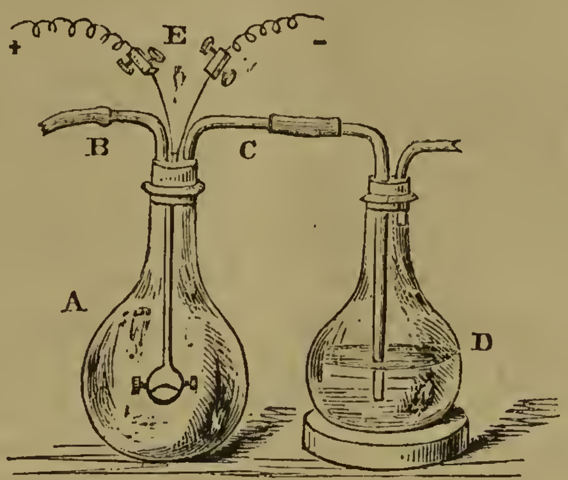
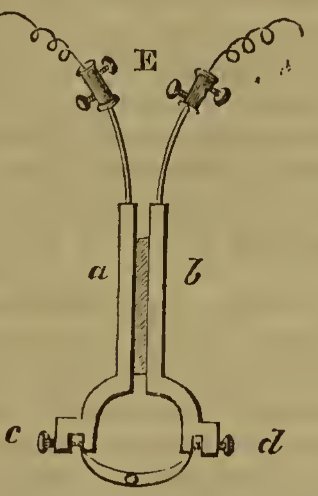


Fig. 2.



Midland Institute, Birmingham,
February 19, 1872.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 7th, 1872.

Dr. Debus, F.R.S., Vice-President, in the Chair.

After the minutes of the previous meeting had been read, Messrs. George T. Atkinson, William Foster, and Benjamin P. Medcalf were formally admitted as Fellows of the Society.

The list of donations having been read, the proposed changes in the Officers and Council for the ensuing year was announced from the chair.

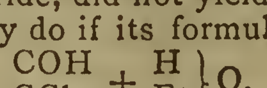
The names of the gentlemen whose certificates were read for the first time were Messrs. William Frederick Donkin, B.A., Charles D. Hunter, Reynold Le Neve Foster, Alexander Noble, W. Little, and William Henry Walbourn. For the third time—Henry Baden Pritchard, James Ballantyne Hannay, J. Vincent Taylor, George Smithers Packer, Robert William Atkinson, and Walter William Fisher, B.A., who were then balloted for and duly elected.

Dr. Debus, having left the chair, which was taken by Professor Williamson, read a paper "*On the Reduction of Ethylic Oxalate by Sodium Amalgam.*" The author pointed out that, by the oxidation of alcohol, C_2H_5,HO, a series of more highly oxidised compounds was formed —viz., glycol, C_2H_4,HO,HO, containing two of hydroxyl, which then yielded successively glycollic acid, $C_2H_4O_3$, glyoxylic acid, $C_2H_2O_3$, and ultimately oxalic acid, $C_2H_2O_4$. One would naturally conclude that if we reversed the process and treated oxalic acid with reducing agents, we should obtain the same series of compounds, but in an inverse order. From these considerations, he was induced to repeat the experiments of Friedlander, who, about the year 1864, by the action of sodium amalgam on ethylic oxalate in the presence of alcohol, had obtained the sodium salt of a new monobasic acid, which he named glycolinic acid, $C_2H_4O_4$. The author, in the first instance, carefully followed the process described by Friedlander. Sodium amalgam was added to ethylic oxalate, mixed with three times its weight of absolute alcohol, until heat ceased to be evolved and the mixture became pasty, taking care, however, to keep the mixture cool; it was found that for this purpose about one molecule of sodium was required for each molecule of ethylic oxalate. On adding a considerable quantity of ether and a little water to the product, it separated into two layers, the lower being pasty, from the sodium salts of the acids formed during the reaction. Lead acetate precipitated a portion of these acids, which, on examination, and by analysis of the calcium salt, was found to be *tartaric acid*. In the portion not precipitated by lead acetate, the sodium salts were converted into calcium salts, and separated by fractional crystallisation into nine portions, all of which, on analysis and from their physical properties, were found to be pure calcium glycollate. The mother-liquors also, with the exception of a minute quantity of the salt of an uncrystallisable acid, contained nothing but glycollate, the author being unable to detect any trace of a compound corresponding to Friedlander's glycolinic acid. An experiment was also made employing considerably less sodium amalgam, but with the same result, nothing but glycolic and tartaric acids being found. The author had also in his possession a few centigrammes of the sodium glycolinate prepared by Friedlander, the crystalline form of which appeared to be identical wtth that of sodium glycollate.

Dr. WILLIAMSON said that no doubt the Fellows had listened with great pleasure to the author's account of the series of accurate experiments he had made on the action of sodium amalgam on ethylic oxalate; but he would like to ask him whether in this reaction glyoxylic acid was not first formed, which then split up into glycolic and oxalic acids? The theoretical question as to whether the hydroxyl ever exceeded in number the carbon atoms present in organic compounds was one of great importance. From a theoretical point of view, certainly, an aqueous solution of carbonic acid might be regarded as CO,HO,HO, there being two of hydroxyl to one of carbon; but it was a remarkable confirmation of the view held by Dr. Debus, that no compound having the composition just mentioned had ever been isolated. Even the hydrate of SO_2 was very unstable.

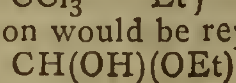
Dr. DEBUS replied that in the second experiment, where the reaction had been stopped before the mixture became alkaline, he had not searched for glyoxylic acid. In the experiment where excess of sodium amalgam had been employed of course it would be useless, as the alkali present would have decomposed the glyoxylic acid if it had previously existed.

Dr. WRIGHT remarked that, in the case of chloral hydrate, there would appear to be two of hydroxyl united to one of carbon, as it was a compound quite analogous to chloral alcoholate. Now the latter, by the action of phosphorus oxychloride, did not yield ethylic chloride, as it would undoubtedly do if its formula were—



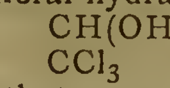
$$\begin{matrix}COH\\CCl_3\end{matrix}+\left.\begin{matrix}H\\Et\end{matrix}\right\}O,$$

so that its composition would be represented by—



$$\begin{matrix}CH(OH)(OEt)\\CCl_3\end{matrix}$$

and the analogous chloral hydrate would then be—



$$\begin{matrix}CH(OH)_2\\CCl_3\end{matrix}$$

Dr. DEBUS replied that, even if it were established that chloral alcoholate had the formula he gave, it would not apply to the remark he had made, which referred only to hydroxyl; he had never affirmed it of a carbon group like ethoxyl. The chloral hydrate he regarded in the same light as any other hydrate.

A paper "*On Metastannic Acid and the Detection and Estimation of Tin*," was then read by the author, Mr. A. H. ALLEN, F.C.S. Having found considerable discrepancy between the various text-books as to the solubility of metastannic acid in acids, he was induced to examine the subject, and finds that the acid which was prepared by the action of nitric acid on metallic tin is soluble to a large extent in concentrated hydrochloric acid. Metastannic acid is completely soluble in concentrated sulphuric acid, and the addition of water to this solution causes the precipitation of ordinary stannic hydrate, and not metastannic acid, as is generally stated; so that the action of sulphuric acid on metastannic acid converts it into ordinary stannic sulphate, $Sn''''(SO_4)_2$, which is decomposed by water, stannic hydrate, SnH_2O_3, being precipitated; but when the liquid is boiled, metastannic acid is formed, and the precipitation of the tin becomes complete. This conversion into stannic sulphate makes the reaction valuable for analytical purposes, the addition of strong hydrochloric acid rendering the solution capable of being largely diluted without any precipitation taking place, so that by the addition of tartaric acid, ammonia, and a magnesium salt, phoshoric and arsenic acids can be readily detected. The author then described several other analytical processes in which this reaction is available, and concludes his paper with some remarks on the action of nitric acid on alloys containing tin and gold, and on the composition of "purple of Cassius," which may be regarded as containing aurous and stannous stannate, ($Au'_2SnO_3,Sn''SnO_3+4aq$).

The Secretary then read a "*Note on the Quantity of Cæsium contained in the Water of the Hot Springs found in Wheal Clifford*," by Colonel PHILIP YORKE, F.R.S. The temperature of the spring is 125° F., and an analysis of the water made by Dr. Allen Miller in 1864 showed it to contain 646 grs. of saline matter per gallon, of which 26 grs. were lithium chloride. He also stated that it contained potassium chloride and a little cæsium chloride. The author has since had some of the water concentrated by evaporation, and ascertained the amount of cæsium present in it, from which it would appear that 1,000,000 parts of the original water contain about 1·7 parts of cæsium chloride. The Dürkheim water, according to Bunsen, contains only 0·17 parts, so that the "Wheal Clifford" spring is at least ten times as rich in cæsium as the Dürkheim water.

The meeting then adjourned until Thursday, March 21, 1872.

NOTICES OF BOOKS.

Chemical Notes for the Lecture-Room: On Heat, Laws of Chemical Combination, and Chemistry of the Non-Metallic Elements. By THOMAS WOOD, Ph.D., F.C.S., Chemical Lecturer at the Brighton and Lancing Colleges, Author of "Notes on Metals," &c. Third edition. London: Longmans, Green, and Co. 1871.

THIS is essentially a school work, and, in accordance with its character, Dr. Wood confines himself to the elementary principles of the science. He says: "I take this opportunity of advising beginners who wish to study chemistry not to commence by reading a book on the subject, but attend first a course of some eight or ten elementary lectures on, say, the components of the atmosphere, thus acquainting themselves with the apparatus, names, modes of thought and expression common to the science." Most cordially do we endorse his advice, while we think that there are few better note-books that could be appended to such a course of lectures than Dr. Wood's.

The Retrospect of Medicine: being a half-yearly journal containing a retrospective view of every discovery and practical improvement in the Medical Sciences. Edited by W. Braithwaite, M.D., and James Braithwaite, M.D. Lond. Vol. lxiv., July—December, 1871. London: Simpkin, Marshall, and Co.

Another volume has been added to this useful record. It embraces a full description of many new medical instruments, and a report of the lectures delivered during the last half year at which any instance of the advancement of medical science occurred. Perhaps the most interesting paper to chemists is that by Dr. Benjamin Ward Richardson, F.R.S., who chronicles his experiences with amyl hydride, or, as he abreviates it, *hydramyl*. Hydride of amyl Dr. Richardson finds to be a solvent of many medicinal substances—among them are iodine (the solution being useful in cases of fœtid ulcerative and suppurative wounds, and in cancer), oils and fats (the solution employed for burns, scalds, &c.). Ammoniated hydride of amyl forms an admirable preservative for pathological preparations. Dr. Richardson places the specimen to be preserved, with half an ounce of the ammoniated solution of the hydride, in a well-stoppered jar. The jar being placed in a cool place, there is not the least occasion to hurry over an examination, for the specimen will keep (even for microscopical research) three or four days in excellent condition.

Dr. Richardson prepares a new anæsthetic agent, which he terms *hydramyl-chlor*, in the following manner:—

"In making bichloride of methylene, we place a mixture of alcohol and chloroform in contact with pure zinc. On the application of heat there is set up a brisk action, during which an equivalent of chlorine from the chloroform ($CHCl_3$) passes to the zinc, and after a free escape of gases bichloride of methylene (CH_2Cl_2) distils over. On one occasion whilst manufacturing some bichloride of methylene, an addition was made to the materials in the retort prepared for making the bichloride of about eight times the volume of amyl hydride. The result was an immediate brisk action without the aid of heat. A copious stream of gases first passed over, and then, the fluid in the receiver having risen in temperature, there began to distil a compound fluid, very light specifically, and of a most agreeable odour. This fluid, when collected, had a specific gravity of 0·699, and it commenced to boil at 92° F. It was much more agreeable for inhalation than the simple hydride, was stable, and acted excellently as an anæsthetic. After carefully testing the vapours of this compound, it was administered fourteen times in cases of extraction of teeth, with results almost identical with those that followed the administration of simple hydramyl. In repeating the process of distillation, the first portion that distilled over was set aside, and none was collected until the temperature had reached 90°, the temperature being sustained between that degree and the degree of temperature of the human body (98°). By this means there was obtained a fluid still very agreeable to breathe and extremely rapid in its action. This fluid has the specific gravity of rectified ether—viz., 0·725. It boils in the warm hand, and may be considered as containing one part of bichloride of methylene in nine of amyl hydride. I propose to call this fluid 'hydramyl-chlor.'"

From many miscellaneous remarks we select those of Dr. John Day on colour tests for blood:—

"Prepare some fresh tincture of guaiacum by putting a few pieces of pure unoxidised guaiacum resin into a small bottle and filling it with alcohol—after shaking a minute or two it is fit for use. The stain must be moistened with this, and if this is followed by a negative result (many substances would produce a blue colour) we must add a few drops of antozonised ether, when, if blood be present, oxidation and bluing of the guaiacum will follow. Robbins's ozonic ether is the best for this purpose. Blood produces no change in the colour of guaiacum, except in the presence of antozone. A liquid has become antozonised when it is changed by absorption of oxygen from the air. All essential oils take on this change rapidly, and they then acquire the property of combining in all proportions with alcohol, and a little essential oil diluted with alcohol will do very well instead of the ozonised ether. By variations of this test, mucus, saliva, and pus may be detected. It appears probable that this test will prove of service in medical cases—in testing for blood in matters vomited or expectorated."

CORRESPONDENCE.

REMARKABLE ELECTRICAL PHENOMENON.

To the Editor of the Chemical News.

Sir,—In carrying out a series of experiments for the purpose of making uninsulated, or imperfectly insulated wires, available for telegraphy; I have met with a remarkable phenomenon which I do not know has been before observed.

By the kind permission of the owners, I submerged a mile or two of naked wire in Wimbledon Lake for experimental purposes, and I found that, on charging it with electricity of either name, it retained the charge obstinately for many minutes. For instance, after attempting to discharge it, at intervals of five seconds, for three minutes, I found it still retained a very considerable portion of the charge, so that I have no doubt it would still have retained some portion after five or six minutes.

This may be due partly to polarisation (so called) of the wires, but I can scarcely think that this would continue for so long a time. I am inclined myself to attribute it to the electrisation of the strata of water surrounding the wire, which, like the glass in a Leyden phial, require a considerable time to lose their polarity entirely. In salt water I find that the phenomenon almost disappears.—I am, &c.,

H. Highton.

2, The Cedars, Putney,
March 11, 1872.

WATER ANALYSIS.

To the Editor of the Chemical News.

Sir,—In August last I recorded my failure with Messrs. Wanklyn and Chapman's ammonia process for the estimation of organic matter in water. I persevered, however, in my attempts to work a process promising such useful results, and I now write to record my success. I have no hesitation in acknowledging my error, as the failure was entirely caused by misplaced confidence in the government apparatus supplied me. The apparatus was of very inefficient appearance; but, as I failed to find details on the apparatus required in Messrs. Wanklyn and Chapman's treatise, I committed the error of taking upon trust the assurances made me that the apparatus was all correct. Anyone acquainted with the deplorable state of chemistry in India can imagine the embarrassment of an analyst in an up-country station totally unprovided with the means of remedying the apparent defects in an apparatus supplied for working a process of a novel description. I will only say that I got out materials of my own, and have been able to construct apparatus that worked successfully.

The process gives good results, apart from the inherent error of the colorimetrical estimation. They agree very fairly with those obtained by the permanganate process (when this is practicable, which is not always the case), and usually confirm the more important deductions obtainable from mineral analysis. Further experience is, however, required before I can speak positively as to the interpretation to be placed on the results of the process. There are peculiarities about Indian waters which render considerable study of them necessary, both from a chemical and hygienic point of view; and their type differs so much from that of British waters, that the greatest mistakes may be made if hygienic opinions be given on them according to the rules accepted at home. For instance, a well water is found to contain nitric acid in such quantity that its quality would be expressed in England by many thousand parts of sewage contamination; yet it is in reality nearly as pure as rain water. I have seen such waters containing much more nitric acid than chlorine, and free from any earthy salts whatever. *Per contra*, I have met with waters obviously contaminated with sewage, yet absolutely free from nitric acid, and containing organic matter not differing from that of pure water. These peculiarities render a good mineral analysis of absolute necessity; for nitric acid may appear in a water free from any suspicion of sewage contamination; nitrogenised organic matters may oxidise into nitric acid, this again may disappear on exposure to atmospheric influences, and each of these points is open to curious exceptions; but the evidence of the mineral constituents never fails, and I regard their accurate determination as of primary importance.

The necessity of modifying both the practice of hygienic analysis and the opinions deduced from it, in the case of Indian waters, is well shown by the results of the Bengal system of water analysis. For four years the waters of the military stations of Bengal were examined on a method drawn up in neglect of the peculiarities of Indian waters. The consequence was that the results, obtained at an enormous expense, were in the greater number of cases most erroneous, and, from a chemical point of view, worthless. Fortunately, the errors were so gross and obvious that no chemist could be deceived by them; still the investigations have turned out an utter blank, and will have to be gone over again before long.—I am, &c.,

Edward Nicholson, Assist. Surg. R.A.,
Analyst of Waters, Mysore, Northern,
and Ceded Districts.

Bellary, February 17, 1872.

MISCELLANEOUS.

The Proposed Memorial to Dr. Priestley.—We hail with satisfaction the proposal of Birmingham to erect a statue of Dr. Priestley. There are but few memorials of scientific men in the country, and at present, excepting a Bath-stone statue in the Museum at Oxford, no public recognition of the great services of Priestley exists. The proposal, though originating in Birmingham, is receiving support from scientific men all over the kingdom, and even beyond; the subscription list including Sir Benjamin C. Brodie, Bart.; Professor Huxley; Dr. Frankland; Sir Rowland Hill, K.C.B.; Dr. W. J. Russell; Professor Michael Foster; Professor Vernon Harcourt; Dr. Herman Kolbe, Liepzig; H. Christian Meyer, Hamburg; and others.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, February 26, 1872.

This number contains the following original papers and memoirs relating more especially to chemistry:—

Invention of the Method of Wine-Preserving by the Application of Heat.—Dr. Balard.—The contents of this lengthy essay are not of general interest, bearing mainly upon a question of priority of invention. A reply to this paper is also published under the following title:—

Reply to Dr. Balard's Paper on the Priority of Invention of the Method of Wine-Preserving by the Application of Heat.—Dr. Thenard.

Application of Secondary Electric Currents for the Purpose of Accumulating or Transforming the Effects of the Galvanic Element.—G. Planté,

Electromotive Force Developed by the Contact of Metals and Inactive Liquids.—J. M. Gaugain.

Two New Isomeric Bromides of Propylen.—E. Reboul.—The author first refers to some of his former researches on the mono-bromated ethylen and propylen, an account of which was published in the above-named periodical more than two years ago, and next records at great length how, while preparing bromide of allyl by Tollens's method, he accidentally obtained a large quantity of a new bromide of propylen isomeric with the other bromide of that base already known, and distinguished from it (the sp. gr. = 1·93 at 19° being the same) by a different boiling-point (which is some 20° higher) and also by its peculiar behaviour with alcoholic potassa solution at a high temperature (100°) and in sealed tube, the result of this reaction being that first a molecule of bromhydric acid is removed, and thereby the bromide of allyl regenerated, and this becoming further decomposed produces allyl-ethylic ether; when water is added to the distillate of the aforesaid fluid, the water separates a lighter liquid exhibiting the odour of allyl-ethylic ether, which on being re-distilled yields that ether, but contaminated with a small quantity of bromated propylen. The mode of formation and of dissociation of the compound alluded to, $C_3H_6Br_2$, justify it being called bromhydrate of bromide of allyl. Another compound, also isomeric with the bromide of propylen, is obtained by the direct union in the cold of bromhydric acid with allylen, whereby two liquids are formed—one of them, boiling at 114°, is the dibromhydrate of allylen—

$$C_3H_4\left\{\begin{matrix}HBr\\HBr\end{matrix}\right.;$$

the second is monobromhydrate, $C_3H_4.HBr$, boiling at 48°, and isomeric with the bromated propylen.

Iodide of Starch.—J. Personne.—This short note simply contains a rectification in reference to an opinion published by E. Duclaux to the effect that the iodide of starch is not a genuine chemical compound but rather a physical mixture, that is to say, that the iodine and starch stand to each other in the same relation as the colouring-matter of lakes to the inorganic materials which form the great bulk thereof. The author's object is chiefly to point out that what was recently put forth by E. Duclaux on this subject, was done so six years ago in precisely the same manner by him.

This number contains also some very important memoirs on meteorology, astronomy, and physiology.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 3, 1872.

This number contains the following original papers and memoirs:—

Experiment for Synthetical Preparation of Parabanic Acid.—B. Tollens.—After first referring to the researches of Henry, Emmerling, Jacobson, and Maly on the derivatives of thiosinnamine, the author states that he has saturated an aqueous solution of urea with cyanogen gas, but at the ordinary temperature no reaction takes place even after the fluid has been standing for some days. When, akin to what takes place with thiosinnamine when treated with cyanogen, urea combines with the latter body, and the dicyamine resulting therefrom is converted into the corresponding oxalyl-urea, parabanic acid must be obtained. The author continues his researches on this subject.

Mono-Allyline and Glycerin-Ether.—B. Tollens.—Reference is first made to the substance which Linnemann and Zotta (*Ann. d, Chem. u. Pharm.*, suppl. viii., p. 254) and von Gegerfelt have described under the name of glycerin-ether, which these *savants* state to be identical with the mono-allyline prepared by the author and described in *Ann. d. Chem. u. Pharm.*, vol. clvi., p. 149, notwithstanding that the glycerin-ether exhibits quite different properties, composition, and products of decomposition. For the purpose of more minute investigation, the author has repeated his former researches on mono-allyline, and has also prepared glycerin-ether. The former substance is a thickish liquid, boiling at from 225° to 240°; formula, $C_6H_{12}O_3$; one of the products of decomposition by heat of mono-allyline is allyl alcohol. Glycerin-ether is a colourless fluid, which is miscible with water in every proportion (according to Linnemann and Zotta, 1 part of glycerin-ether requires 20 parts of water for solution); when boiled with dilute sulphuric acid, this ether is at first hardly acted upon at all, but when the fluid becomes more concentrated it becomes yellow-coloured, while very irritating vapours are given off, which reduce ammoniacal silver solution. This exhaustive essay further contains a detailed account of the behaviour of mono-allyline and glycerin-ether with various reagents; mono-allyline and glycerin-ether are not identical substances, but there may exist (which is the subject of further researches) a genetic relation between these two bodies.

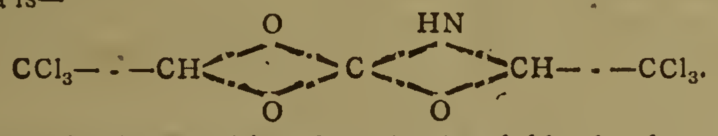
Bibrom-Propionic Acid.—G. Munder and B. Tollens.—When allyl-alcohol bromide, boiling at from 210° to 214°, is treated at a gentle heat with nitric acid (sp. gr. at from 1·4 to 1·48), the result is the formation of bibrom-propionic acid, which, when purified, is a crystalline body, $C_3H_4Br_2O_2$, fusing at 64° to 64·5°, boiling with partial decomposition at between 220° and 240°, and readily soluble in water and ether. The authors describe at length a series of experiments, mainly made with the view to ascertain whether this acid is identical with a bibrom-propionic acid described by Friedel (*Ann. d. Chem. u. Pharm.*, suppl. iii., p. 72); as far as the experiments have been concluded, the authors of this paper state that the acid they have obtained is identical with that just mentioned, and the constitutional formula of both is $CH_2Br\text{---}CHBr\text{---}COOH$.

Observations on the Analysis of the Milk of Women.—A. Schukoffsky.—In the introduction to this paper the author reviews the more recently described methods of analysis of the milk yielded by women, and points out the defects of these methods, after which a detailed description is given of a process of analysis (estimation of casein, butter, milk-sugar, saline matter, and water) of the fluid alluded to by its peculiar behaviour with ether and very strong alcohol. To from 20 to 25 c.c. of milk, an equal bulk (18 to 20 grms. by weight) of ether is added, and, next, from 30 to 35 c.c. of very strong alcohol (90 to 96 per cent) are added, whereby the casein is separated (coagulated), and after some twenty-four hours the milk-sugar is also thrown down, and can be collected on a filter along with the casein; these substances are washed with very strong alcohol and anhydrous ether; the latter fluid is next separated by distillation on a water-bath, and the remaining alcohol, carefully evaporated, leaves the butter contained in the milk.

Amblygonite from Montebras.—Dr. C. Rammelsberg.—The contents of this essay point out the errors of Moissenet's analysis of the mineral already mentioned in our pages (see vol. xxv., p. 45). The eminent German mineralogist just named states that he has very minutely investigated the Montebrasite, and finds it to be amblygonite, and to consist, in 100 parts, of—Phosphoric acid, 48·55; alumina, 36·36; lithia, 7·96; soda, 0·93; potassa, 0·40; fluorine, 10·06; total, 104·36. The mineral alluded to is identical with the amblygonite found at or near Penig, in Germany.

Action of Chlorine and Bromine upon an Alcoholic Solution of Hydrocyanic Acid.—C. Bischoff.—Notwithstanding the very high scientific value of the contents of this monograph, it is not suited for useful abstraction.

Contribution to the History of Chloral.—C. Bischoff.—This paper treats on the action of the vapour of cyanic acid upon chloral, which, when carefully conducted, results in the formation of a new body, $C_5H_3Cl_6NO_5$, a solid substance, fusing at from 167° to 170°, and yielding, when boiled with caustic potassa solution, chloroform, formic and carbonic acids, and ammonia, that is to say, the products of dissociation of chloral and cyanic acid. The new body's constitutional formula is—



$$CCl_3\text{---}CH\overset{O}{\underset{O}{\lessgtr}}C\overset{HN}{\underset{O}{\lessgtr}}CH\text{---}CCl_3.$$

It consists of a direct addition of 2 molecules of chloral and 1 molecule of cyanic acid—$2C_2HCl_3O + CNHO = C_5H_3Cl_6NO_3$.

Derivatives of Fulminic Acid.—E. Sell and R. Biedermann.—This paper treats chiefly on the action of iodine upon fulminate of mercury, whereby an organic compound, $C(CN)(NO_2)I_2$, is obtained, corresponding to the substance obtained by Kekulé by the action of bromine upon the fulminate just named. The iodine-containing body just alluded to is a crystalline substance, fusing at 70°, and decomposed at 170°, evolving vapours of iodine; treated with caustic alkaline solutions at a higher temperature, ammonia is given off; with nitric acid, hardly any reaction takes place; while concentrated sulphuric acid sets iodine free; the final product of the reduction of this body with tin and hydrochloric acid is methylamine. The authors observe, as regards the action of the three haloids—chlorine, bromine, and iodine—upon fulminate of mercury, that chlorine eliminates the mercury as well as the cyanogen group; bromine leaves a portion of the cyanogen group in the shape of bibromo-nitro-aceto-nitrile; while iodine does not act upon the cyanogen group at all; the following formulæ exhibit these reactions:—

Cl.	Br.	I.
$C(NO_2)Cl_3$	$C(NO_2Br_3$ $C(NO_2)(CN)Br_2$	$C(NO_2)(CN)I_2$

Isocyanate and Isocyanurate of Benzyl.—E. Letts.—In the introduction to this valuable essay the author refers at considerable length to the researches of Drs. Wurtz, Cloëz, A. W. Hofmann, Olshausen, and Canizzaro on subjects closely related to his researches. Next, a series of new bodies, their preparation and properties, are minutely described: among these we quote the following:—Benzyl-isocyanate is a colourless fluid, which was not, however, obtained free from benzyl chloride, and did not exhibit a quite fixed boiling-point, but this, notwithstanding the products of conversion and derivatives from this body, made it clear that the compound

$$C_8H_7NO = \left\{\begin{matrix} CO \\ C_7H_7 \end{matrix}\right\} N = \left\{\begin{matrix} CO \\ C_6H_5.CH_2 \end{matrix}\right\} N$$

had been obtained. The other bodies described at great length in this exhaustive essay are—Monobenzyl-urea; dibenzyl-urea; phenyl-benzyl-urea; and benzyl-isocyanurate, a solid crystalline substance, insoluble in water, difficultly soluble in ether, somewhat more readily soluble in hot alcohol; fusing-point, 157°; boiling-point, above 320°.

Conversion of Oil of Turpentine into Cymol.—A. Oppenheim.—The contents of this lengthy monograph are, notwithstanding the very high scientific merits, not suited for abstraction, an observation also applying to the two following essays, of which we quote the headings of the sections:—

Aromatic Phosphines.—Dr. A. W. Hofmann.—Benzyl-phosphine—

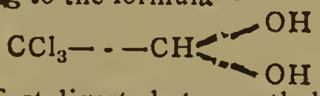
$$C_7H_9P = \left\{\begin{matrix} C_7H_7 \\ H \\ H \end{matrix}\right\} P;$$

dibenzyl-phosphine—

$$C_{14}H_{15}P = \left\{\begin{matrix} C_7H_7 \\ C_7H_7 \\ H \end{matrix}\right\} P.$$

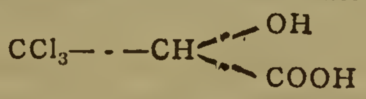
Products of the Oxidation of Methyl- and Ethyl-Phosphines.—Dr. A. W. Hofmann.—Monomethyl-phosphinic acid; silver, lead, and barium salts of this acid; dimethyl-phosphinic acid; silver, lead, and barium salts of this acid; ethyl-phosphinic acid; diethyl-phosphinic acid.

Chloral Cyanhydrate and Trichlor-Lactic Acid.—C. Bischof and A. Pinner.—The authors first briefly refer to the researches of Dr. Städeler on the action of hydrocyanic and hydrochloric acids upon chloral (*Ann. d. Chem. u. Pharm.*, vol. cv., p. 293), and then state that they have repeated these researches, causing the acids alluded to to act separately (at least hydrocyanic) as well as jointly on chloral. The result of the action of hydrocyanic acid, aided by heat, upon that body is the formation of a solid crystalline substance, readily soluble in water, alcohol, and ether; very bitter tasted; yielding, by dissociation, chloroform, hydrocyanic and formic acids; and yielding, by elementary analysis, results leading to the formula—



$$CCl_3\text{---}CH\begin{matrix} OH \\ OH \end{matrix}$$

When this cyanide is first digested at a gentle heat with hydrochloric acid, and the resulting fluid next evaporated upon a water-bath, there remains sal-ammoniac, along with a yellowish coloured liquid of the consistency of a syrup, which, on being taken up by ether and evaporated in a vacuum, yields a crystalline body, which (also by the salts it yields) was ascertained to be trichlor-lactic acid—



$$CCl_3\text{---}CH\begin{matrix} OH \\ COOH \end{matrix}$$

The authors continue their researches on this subject.

A Third Nitraniline.—J. F. Walker and Th. Zincke.—The authors record in this lengthy essay, which treats on the different nitranilines in general, their researches on a peculiar nitraniline obtained by them from the γ-brom-nitro-benzol of Hübner and Alsberg, and the nitraniline thus obtained has been termed meta-nitraniline, a solid crystalline body. The following tabulated form exhibits a review of the different kinds of nitraniline:—

Ortho series.	Meta series.	Para series.
α-Brom-nitro-benzol, fuses at 125°.	γ-Brom-nitro-benzol, fuses at 37° to 38° (Hübner and Alsberg).	β-Brom-nitro-benzo fuses at 56° (Griess).
α-Brom-aniline (from acetanalide).	γ-Brom-aniline (Hübner and Alsberg).	β-Brom-aniline (Griess).
Nitraniline (from acetanalide), fuses at 146°.	Meta-nitraniline, fuses at 66°.	Para-nitraniline, fuses at 108°
Ortho-nitro-phenol, fuses at 110°.	Nitro-phenol, fuses at 45°.	Unknown binitro-benzol.
Bibrom-benzol, fuses at 89°.		

This number contains the very excellently written biographies of the late Dr. Adolf Strecker, illustrated by a photogram, and of Dr. Carl Julius Fritzsche; the former memoir being from the hand of Dr. R. Wagner, and the latter from Dr. A. Boutlerow. The two deceased men, the first-named a German, the other a Russian *savant* (native of Saxony), were deservedly and widely known in the scientific world.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 3, 1871.

In addition to a series of essays and papers more especially bearing upon the geology, mineralogy, palæontology, and geognosy of the Austro-Hungarian empire, this number contains the following papers relating to chemistry:—

Fluorescent Amber.—L. Walcher von Moltheim.—A piece of amber about 4 centims. in length was found in 1869 at the mouth of the river Simeto, near Catania (Sicily); the colour of this substance is blue, but honey-yellow when seen against the light, with the exception, however, of the outer crust, which always exhibits the last-named hue; the substance is turbid internally. From the investigation made with the application of differently coloured light, it appears that this piece of amber consists internally of a very strongly-fluorescent mass, and a non-fluorescent outer crust.

Zincspath from Raibl (Carinthia).—Dr. E. Ludwig.—This mineral was found to consist, in 100 parts, of—Carbonic acid, 31·33; silica, 0·27; oxide of zinc, 59·59; oxide of iron, 7·42; water, 1·44; total, 100·04.

Meteorite from Shergotty.—Dr. E. Ludwig.—This stone was found to consist, in 100 parts, of—Silica, 50·21; alumina, 5·90; protoxide of iron, 21·85; magnesia, 10·0; lime, 10·41; soda, 1·28; potassa, 0·57; total, 100·22. In the inaugural dissertation of Dr. Frank Crook ("On the Mineral Constitution of the Ensisheim, Mauerkirchen, Shergotty, and Muddoor Stones;" Göttingen, 1868) the result of the analysis of the Shergotty (British India) meteorite is quoted as follows, percentically:—Nickel-iron, 9·44; chromite, 0·32; silica, 36·21; alumina, 1·87; protoxide of iron, 27·04; magnesia, 24·11; lime, 0·44; soda, 0·22; potassa, 0·11; total, 99·76. Dr. E. Ludwig states the following respecting this discrepancy:—A piece of the genuine Shergotty stone was sent direct from Calcutta to Vienna by Dr. T. Oldham, and Dr. F. Crook obtained from Vienna, through the kindness of Dr. F. Wöhler at Göttingen, a few small pieces of the stone alluded to, but it is evident that Dr. Crook has mistaken the sample of another mineral or meteorite for that of the Shergotty, Dr. Ludwig having taken his sample for analysis from the larger one kept in the Mineralogical Museum at Vienna.

Bayerisches Industrie und Gewerbe-Blatt (double number), November and December, 1871.

In addition to the official notices and reports usually met with in this periodical, this number contains the following original paper relating to chemistry and collateral sciences:—

Silvering of Glass.—Dr. Bothe.—This lengthy paper contains several hints and practical receipts for the purpose of silvering glass, from which we quote the following particulars:—Ingredients and apparatus required—Sal-Seignette (tartrate of potassa and soda), solution of that salt in water, 1 grm. to 50 of water; of ammonia liquida, 50 c.c.; solution of nitrate of silver, 1:8; glass flask of 1000 c.c. cubic capacity for the reduction fluid, and a like flask for the silvering fluid. Reduction fluid—Mix with 900 c.c. of pure distilled water, 90 c.c. of the above-mentioned solution of the Seignette salt; pour this liquid into the glass flask, and let it boil violently; while thus boiling add 20 c.c. of the solution of nitrate of silver, and continue the boiling for some ten minutes longer; this fluid, which now contains oxytartrate of oxide of silver, can be kept for any length of time, and improves on keeping; if left in the flask, which for convenience should be labelled (1), the liquid has to be filtered before use through filtering-paper. The silvering fluid is made in the following manner:—Nitrate of silver is first dissolved in distilled water, and next ammonia added until the precipitate at first appearing is again dissolved; the liquid is next filtered, and diluted with so much water that 1 grm. of the silver salt makes 100 c.c. of solution. For the purpose of silvering, equal quantities by bulk of the fluids alluded to are first each separately filtered, and next poured together into a vessel of suitable size and shape wherein the glass plate to be silvered is then placed; this glass should be first scrupulously cleaned.

Bulletin de la Societé d'Encouragement pour l'Industrie Nationale, December, 1871.

This number does not contain any original papers or memoirs relating to chemistry, but, under the heading "Miscellany," it is stated that, to prevent solutions of gum, mucilage, and ordinary ink becoming mouldy, it is only necessary to add a few crystals of sulphate of quinine to those fluids.

Les Mondes, February 22, 1872.

This number does not contain any original papers relating to chemistry.

NOTES AND QUERIES.

Artificial Pumice.—Can any of your readers give me information respecting the nature of artificial pumice referred to in Bunsen's account of his filter-pump?—T. D.

Fractional Distillations.—Would your readers kindly inform me in your next issue whether it is proper, in fractional distillations, to let the bulb of the thermometer be in the liquid or above it?—H. D.

Prussian-Blue and Bichromate of Potash.—Can any of your readers kindly inform me where prussian-blue can be procured in powder soluble in water? I understand it is used largely in America amongst paper makers for colouring and tinting paper, but I am not aware of its being used here except in the form of paste; its commercial value is about 1s. per lb. Also, is bichromate of potash manufactured on the Continent, or is it all manufactured by the two Scotch makers?—Ignoramus.

MEETINGS FOR THE WEEK.

Monday, March 18th.—Medical, 8.
—— Anthropological, 8.
—— London Institution, 4. Prof. John Ella, "On Elementary Music."
Tuesday, 19th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Zoological, 9.
Wednesday, 20th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 21st.—Royal, 8.30.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
—— London Institution, 7.30. Lecture.
—— Chemical, 8.
Friday, 22nd.—Royal Institution, 9. Mr. J. N. Lockyer, F.R.S., "On the Results of the last Eclipse Expedition."
—— Quekett Microscopical Club, 8.
Saturday, 23rd.—Royal Institution, 3. Mr. Moncure Conway, "On Demonology."

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THE CHEMICAL NEWS.

VOL. XXV. No. 643.

ON THE NORMAL PARAFFINS.*

By C. SCHORLEMMER, F.R.S.

SOME of the results of this research have already been published in two previous communications.† It was there pointed out that the constitution assigned to the normal paraffins (*i.e.*, that they contain the carbon atoms linked together in a single chain) was ascertained partly by preparing them by synthesis from other normal compounds, and partly by studying the oxidation products of the alcohols obtained from them. The best method to prepare these alcohols is to pass a current of dry chlorine into the vapour of the boiling hydrocarbon; a mixture of a primary and a secondary chloride is obtained‡, and these, by heating the mixture with glacial acetic acid and potassium acetate to 200°, are completely decomposed, the primary chloride yielding the corresponding acetate, whilst the secondary compound partly splits up into an olefine and hydrochloric acid, and partly is converted into the acetate of the secondary radical. By treating the acetates with an alcoholic solution of caustic potash, the alcohols are formed, which can be only approximately separated by fractional distillation, as the difference between their boiling-points is only about 10°.

Pentane, or normal amyl hydride, C_5H_{12}, boiling at 37°—39°, is found in considerable quantity in Pennsylvania petroleum. The secondary pentyl alcohol or *methyl-propyl carbinol*, $\left.\begin{matrix}CH_3\\C_3H_7\end{matrix}\right\}CHOH$ (boiling-point 120°—122°), gives an oxidation *methyl-propyl ketone*, $\left.\begin{matrix}CH_3\\C_3H_7\end{matrix}\right\}CO$, which on further oxidation splits up into acetic acid and propionic acid. The *primary pentyl alcohol* is identical with the normal amyl alcohol, which Lieben and Rossi obtained from normal butyric acid, and yields on oxidation *normal valerianic* acid, boiling at 184°—187°.

Hexane, or normal hexyl hydride, C_6H_{14}.—(1) *Hexane* from petroleum, boiling at 69°—70°, yields the following derivatives:—(a) *Methyl-butyl carbinol*, $\left.\begin{matrix}CH_3\\C_4H_9\end{matrix}\right\}CH.OH$, (boiling-point 140°—142°), the oxidation products of which consist of *methyl-butyl ketone*, $\left.\begin{matrix}CH_3\\C_4H_9\end{matrix}\right\}CO$, and acetic acid and *normal* butyric acid. (b) *Primary hexyl alcohol*, boiling at 150°—155°, from which *caproic acid* boiling at 201°—204° was obtained.

(2) *Hexane* from mannite was obtained by acting with hydrochloric acid and zinc upon the secondary hexyl iodide prepared from mannite. It boils at 71·5°, and its sp. gr. at 17° is 0·6630. The derivatives were the same as those of the hexane from petroleum; it must, however, be stated that the boiling-points of some were a little higher than those of the petroleum hydrocarbon, and there was also a marked difference observed between the two caproic acids. That from mannite gave a well-crystallised barium salt, whilst that from petroleum could only be obtained in the amorphous state; but as the two secondary alcohols yield both normal butyric acid, the chemical constitution of the two hexanes must be the same.

(3) *Dipropyl*.—This hydrocarbon was prepared by acting with sodium on primary propyl iodide; boiling-point 69°—70°; specific gravity at 17° = 0·6630. The quantity obtained was too small for further investigation; but the mode of its formation shows that it must have the same constitution as the two other hexames.

Heptane, or normal heptyl hydride, C_7H_{16}; boiling-point 97·5°—99°. This hydrocarbon, which is also found in petroleum, gives a secondary alcohol (boiling-point 160°—162°), which is *methyl-pentyl carbinol*—

$$\left.\begin{matrix}CH_3\\C_5H_{12}\end{matrix}\right\}CH.OH,$$

as the acetone obtained from it yields on oxidation acetic acid and *normal valerianic acid*. The primary heptyl alcohol boils at 170°—172°; on oxidising it, *œnanthylic* acid, boiling at 219°—222°, was formed, which was found to be identical with the acid obtained from castor-oil.

Octane, or normal dibutyl, C_8H_{18}, is easily obtained by the action of sodium or normal butyl iodide. It boils at 123°—125°, and has at 17° the sp. gr. 0·7032. As the octane from methyl-hexyl carbinol, as well as that which Zincke obtained from primary octyl alcohol, have the same boiling-points and specific gravities, it appears most probable that these three hydrocarbons are identical.

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[*] Abstract of a paper read before the Royal Society.

[†] *Proc. Roy. Soc.*, No. 123 (1870), and No. 219 (1871).

[‡] The same mixture is obtained by the action of chlorine in the cold or in presence of iodine; but at the same time a large quantity of higher chlorinated substitution products is formed, which is not the case by acting with chlorine on the vapour.

ON THE ACTION OF HEAT UPON SOLUTIONS OF HYDRATED SALTS.

By CHARLES R. C. TICHBORNE, F.C.S., M.R.I.A., &c.

WHEN considering the dissociative action of heat upon water of hydration, some evidence was naturally sought amongst those salts which present a change of colour when passing from the dry to the hydrated state. The salts experimented with were those of cobalt, copper, and nickel.

As regards such bodies, it is a general characteristic that neutral solutions of any of their chlorides do not change colour on boiling the aqueous solutions at ordinary atmospheric pressure, nor does the amount of dilution affect the tint any further than what would be due to attenuation. But in no case where a colour-change is evinced between the dry and hydrated salt have I failed in obtaining a dehydration of the salt when using extraordinary pressure. Such chromatic changes differ from those produced by the basic condition of the salt, as will be seen further on.

Let us take, for instance, the dehydration of the salts of cobalt, which is evinced by a well-known change of colour, the conversion of the light rose colour into a dark and pure blue. My observations conclusively prove that waters of crystallisation or of hydration are easily held asunder in aqueous solutions by the dissociative influence of heat; that is to say, in a similar manner to the phenomena noticed as regards the bases or ultimate molecules in the trioxide group.* No amount of boiling will, however, convert a pink solution of cobalt into a blue one. But it was observed by Proust many years ago, that, on evaporating a *strongly acid* solution of a cobalt salt to a concentrated point, he got a permanently blue solution, which he considered was due to the abstraction of the water of hydration by the acid. Proust also stated that he had obtained from such a solution blue crystals, supposed to be the anhydrous salt; this requires verification.

Conceiving that the cobalt salts would, from their chromatic display, be most applicable to illustrate the dissociation of water of hydration by heat, I was rewarded by finding that it answered admirably for this purpose, and gave results which may be used as beautiful lecture experiments. The thermanalytic point of the cobalt salts being above 100° C., no result will be obtained on boiling a neutral solution; but if any substance capable of exerting an affinity for the water of hydration be introduced, the thermanalytic point of the salt will be lowered,

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[*] Tichborne "On Molecular Dissociation." CHEMICAL NEWS, vol. xxiv., pp. 123, 199, 209, 220.

as shown by Proust's experiment. Sulphuric and other acids, chloride of calcium and other hygroscopic salts, sugar, and other hygroscopic, but otherwise indifferent substances, act in a similar manner.

However, as the quantity of these dehydrants required to affect the cobalt solution was considerable, I used alcohol to lower the thermanalytic point. Chloride of cobalt[*] dried at 100° C., dissolved in pure and absolute alcohol, gives a magnificent pure blue, free from the slightest tinge of purple. For this purpose it is necessary that the alcohol should be free from water, and it is desirable to rectify from anhydrous sulphate of copper or chloride of calcium. The following instructive illustrations may be shown with chloride of cobalt:—

(1). A blue alcoholic solution obtained in the above manner is placed in a deep beaker, and water is cautiously poured down the side of the vessel. Two layers will be produced, of two different colours, and will remain in this condition for some considerable time by virtue of their different gravities. The upper layer will be blue, and contains the anhydrous salt; the lower layer will be pink, and contains the hydrated salt, rendered so by the direct addition of water.

(2). A beaker of the alcoholic solution which has been hydrated by the addition of a considerable amount of water is peculiarly sensitive to heat. If it is gradually heated upon a water-bath, it passes, as the temperature rises, through all the shades of pink and purple until a pure blue is produced, giving the same absorption spectrum as that obtained from the anhydrous salt. The thermanalytic point is so lowered by the alcohol present that the water of hydration of the cobalt salt is gradually but perfectly dissociated. If we now submerge this beaker half-way into a freezing mixture, we in a short time obtain similar chromatic and chemical results as in the first instance; but in this case the phenomena are brought about by different means. In the beaker we have two layers exhibited—the upper, or blue one, containing the anhydrous salt, the water being present, although dissociated.

(3). It was easy to portend that, although impossible at ordinary atmospheric pressure, and in an ordinary aqueous solution, to dissociate the water, it is only necessary to boil such a solution under a sufficient amount of pressure to obtain the thermanalytic point. This was demonstrated by the following experiment:—A weak solution of chloride of cobalt was sealed up in a glass tube, two-thirds of the capacity of which were empty. On boiling the liquid in this tube the solution gradually passes with the increment of heat through all the shades of purple until the contents ultimately become of a pure blue. Thus, in this aqueous solution we have attained, by extraordinary pressure, the temperature necessary for the separation of the water. The change of colour may be easily observed as it occurs in the capillary tube by holding any white material at the back of the tube and opposite the experimenter.

Chloride of copper, $CuCl_2$, gives a beautiful blue solution in water; this colour is characteristic of its hydrate. It gives a brownish yellow salt in the anhydrous state; its solution in alcohol gives a greenish yellow, or, better still, in pure ether which has been acidulated, a brownish-yellow appearance.

The beautiful blue solution of the neutral salt, when heated in a sealed tube to a high temperature, becomes gradually green, yellow, and ultimately a dark brown and nearly opaque liquid. As it cools, it gradually associates the water of hydration and passes again through all the shades; but when cool it becomes a little opalescent, from the formation of a bluish basic precipitate. Therefore, for illustrating this experiment it is better to use a slightly acidulated solution, which, from the presence of the acid, is even more sensitive to heat, and regains its original condition on cooling; hence this experiment can be performed with the same tube *ad infinitum*.

A solution of sulphate of copper, heated in sealed tubes, gives somewhat similar results as regards dehydration; but a basic salt is at once determined, even in an acidulated solution.

The nickel salts do not, as a rule, so strikingly illustrate this phenomenon of chromatic change, although, as well known, the hydrated salts are green, and the anhydrous salts more or less yellow. Heated under pressure, the chloride seems to be intensified in colour in the first instance, then becomes yellow, and ultimately a dark yellowish green. This, at first sight, would appear somewhat anomalous; but on examination its anhydrous alcoholic solution presents similar anomalies on cautiously adding a weaker alcohol.

It is necessary in these experiments that considerable caution should be used, as an explosion frequently occurs. As wire gauze would prevent the gradual change in colour from being observed, it is better to heat the experimental tube in a second glass one considerably larger. The experimental or hermetically-sealed one should be as small in calibre as the necessary observations will allow of. The volume of liquid necessary for proper observation will of course depend upon the depth of colour of the solution, and the amount of solution should have a small proportion to the capacity of the tube. Tubes for this purpose are best made by taking a white glass tube of some considerable strength, and drawing this out until it has a diameter of $\frac{2}{100}$ths of an inch. My attention was first drawn to the value of capillary tubes for experiments similar to the above from a lecture delivered by Dr. Andrews.[*]

The most important observations made in connection with this investigation is the distinction observed between the effects of dilution in colour-changes attending the basic condition and in colour-changes attending dehydration. As it might have been predicted, it is exactly the reverse in one case to the other. In a report recently read at this Academy, I pointed out that chromatic changes resulting from the formation of basic salts by dissociation (*i.e.*, chromic and ferric salts) is influenced by dilution lowering the thermanalytic point; this is due to the basic action of the water itself. But it is self-evident that an increased volume of water will act differently in cases where the change of colour depends upon dehydration. In the first class, the increase of volume in the water will assist the dissociation and lower the thermanalytic point; in the second case, the increase in the volume of water retards the dissociation and raises the thermanalytic point. In the first class of phenomena the dissociatability is in ratio to dilution; in the second class it is in inverse ratio to dilution. The thermanalytic point may be determined approximatively by taking a capillary tube containing the salt to be tried, and putting this into a tube containing a mixture of chloride of calcium and glycerine; this gives a bath which will carry the temperature over 200° C. Heat is now carefully applied at the same time that the temperature is determined by a thermometer, which can be used to keep the whole moving. An observation made with chloride of cobalt is placed in juxtaposition with ferric chloride to illustrate these remarks.

Dissociation Attended with a Basic Result, Fe_2Cl_6.

Percentage of Salt in Water (Hydrated).	Temperature of Dissociation. ° C.	Colour.
50	over 100	—
10	94	—
5	82	—

Dissociation of Hydrated Water, $CoCl_2$.

Percentage of Salt in Water (Hydrated).	Temperature of Dissociation. ° C.	Colour.
50	60 100	change. blue.
25	85 135	change. blue.
10	180 207	change. blue.

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[*] Glycerine does not affect these salts. The composition of the hydrated salt is $CoCl_2 6H_2O$ (Marignac).

[*] "On the Continuity of the Liquid and Gaseous States of Matter." Chemical News, vol. xxi., pp. 101, 111.

The dissociation, therefore, of water of hydration of salts when in solution is gradual, and progresses with the increment of temperature until perfect dehydration takes place. It is evident, also, that in the salts tried perfect dissociation takes place at a higher point than the boiling-point of water when operating at ordinary pressure. With very concentrated solutions it becomes difficult to determine how far dissociation of the more ultimate molecules may play an exceptional part in the decomposition. Lastly, we also perceive that dilution raises the thermanalytic point, as regards the molecules of hydration.

ON A FORM OF ELECTRO-MAGNETIC SEISMOGRAPH ADAPTED FOR INDICATING AND REGISTERING MINUTE SHOCKS.

By WILLIAM SKEY,
Government Analyst, New Zealand.

From what I can learn the kind of electro-magnetic seismograph now in use is merely an adaptation of certain electro-magnetic instruments to the old mercurial seisometer, in which the movement of the mercury, as during an earthquake, joins the metal to a wire suspended near it, and so closes the circuit of a voltaic cell or battery, in doing which an electro-magnet is set to work for registering the turn and direction of such movement.

An instrument of this description I have recently been experimenting with, and I experience a very great difficulty in adjusting the distance of the mercury from the wire so as to enable the instrument to indicate shocks—except these are of some considerable violence relatively speaking; and, again, I find there is the danger of the two permanently adhering, so that only the first shock of a series might be registered; there is besides, as is well known, compensatory apparatus required on account of changes of temperature. This deficiency in delicacy and these other defects of this instrument I have therefore sought to remedy by considerably modifying it in several of its parts; the principle to which I have worked, and that which alone is novel in its introduction here, being that of enforcing the earthquake to *break*, in the place of *closing*, an electric circuit. For this method of using the electric current I find it far the best to use solid metal for both sides or parts of the break in place of one fluid and one solid as used hitherto.

The following is a short specification of the instrument I have designed to fulfil these objects, and which, in its present or modified form, I would, from a knowledge of its capabilities, beg to recommend to those interested (scientifically) in the phenomena alluded to:—

A small block of metal, having a thin slip of platina attached, or a small wire of this metal projecting a little apart from it horizontally, is connected with an electro-magnet with keeper suspended, and this with a single cell of a battery.

A very fine silver wire (that used for sewing wounds), 3 feet long or so, joined at its lower extremity by a little platina wire, depends from a point above, so that the two platina wires may intersect; a firm adjusting screw or other apparatus set contiguous to the point of suspension enables one to put this point in such a position that these wires are allowed to press but very slightly upon each other. The silver wire is connected with the other pole of the cell through this point of suspension through a vertical galvanometer. The shock-receiving part is placed underground to avoid the interference of winds or that of violent detonations, the metal block being set upon a wooden pile driven some distance in solid earth.

When properly set a single make and break contact of this kind is so sensitive that the impact of 3 pounds of stone, falling from a height of 5 feet upon the ground, at a distance of 50 feet from it, moved the needle of the galvanometer very determinately. The intervening ground was clay.

In using a series of these and the needle of the galvanometer, it seems advantageous, in order that the needle may be kept in a determinate position during periods of quiet, to use only one galvanometer for the breaks of the opposite quarters, and but one cell, dividing the current of this cell equally between the two breaks, and passing each portion oppositely through a separate coil on either side of the needle. Thus the needle once set at zero cannot move far from it, except during shakes, no matter how the intensity of the current varies. On the top of each needle a wire rests in such a manner that it drops vertically when the needle is deflected a little to either side, fixing the needle one side or the other of it according to the direction the shake moves in. In order to obtain distinct indications as to the direction of a shake with an instrument of this kind, it seems necessary to place the breaks a considerable distance apart from each other. It is very probable that, if required, very much greater delicacy would be given to this instrument by largely increasing the number of breaks (or shock-receivers) and connecting them throughout with a single cell or battery in such a manner that, were any one of them to disconnect, the circuit stops. In this way it is thought that a shock so very slight as to be quite unable to break any of these contacts would largely reduce the area of contact through the system, and so considerably curtail the flow of the current for the period of such shake, thus giving an indication of this, where otherwise it would be unrecorded.

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* Read before the Wellington Philosophical Society, November 25th, 1871.

ON THE
ACTION OF LOW TEMPERATURES ON THE SO-CALLED SUPERSATURATED SOLUTIONS OF SODIC SULPHATE.

By L. C. DE COPPET, Ph.D.

In the last number of the Chemical News (vol. xxv., p. 102) appeared a paper by Mr. Charles Tomlinson on a paper to which I have devoted much attention during the past two years, viz., "On the Action of Low Temperatures on Supersatured Solutions of Glauber's Salt." I believe the following to be a fair *resumé* of Mr. Tomlinson's paper; I make it chiefly in the author's own words, italicising the more important passages.

When a solution of 1 part, 2 parts, or 3 parts of Glauber's salt to 1 of water is cooled to 26° F. and under, "crystals of a peculiar opaque white" are deposited. These crystals are "not like the transparent octahedra that are thrown down when these solutions cool to 40° F. and under," but "resemble in texture newly formed white-lead." "*At whatever temperature they may be formed below 26° F., their formation causes the thermometer to rise to 26°, and that, too, in solutions of 1 part, 2 parts, or 3 parts of salt to 1 of water.* This opaque salt is sometimes amorphous, and then it covers the surface of the flask like thick whitewash. This effect occurs when the flask is much agitated in the freezing mixture."

"Thus," says Mr. Tomlinson, "*one more hydrate is added to those already known as belonging to this remarkable salt. It doubtless contains less water than the seven-atom hydrate; but I know of no method of testing its hydration, since its existence depends upon the low temperature and shelter from the action of nuclei.* In this way it resembles the various hydrates described in my paper in the *Transactions.*"

Mr. Tomlinson mentions M. Violette as the only writer who has noticed the formation of this new hydrate “qui cristallise difficilement en forme de choux-fleurs.”[*]

In the course of my experiments on the congelation of saline solutions, ordinary and supersaturated,[†] I have made the phenomena described by Mr. Tomlinson the subject of careful investigation, and do not hesitate in affirming that both he and M. Violette have misunderstood their true nature. The supposed new hydrate of sodic sulphate is simply *ice* mixed with variable quantities of the long since discovered seven-atom hydrate, $Na_2SO_4,7H_2O$.

To make this clear I must enter into a few explanations.

When a saline solution is cooled to a sufficiently low temperature, it freezes—*i.e.*, the water of the solution is changed to ice (Blagden, Despretz, Rüdorft). Water containing saline substances in solution freezes at a lower temperature than pure water; the depression of the freezing-point increases with the quantity of substance, and is, in many cases, in exact proportion to the quantity of salt dissolved.

A solution may very easily be cooled without freezing to temperatures many degrees below its freezing-point, but under no circumstances can the water of the solution be made to congeal at temperatures *above* the freezing-point. In the former case, as soon as ice begins to form, the temperature rises to the freezing-point, and there remains stationary for some time; then it begins to fall again slowly, because, as more ice is separated from the solution, the latter becomes more concentrated and the freezing-point is gradually lowered. Hence the exact determination of the freezing-point is an operation requiring some care.[‡]

When, however, in a saturated or supersaturated solution salt crystallises at the same time the water freezes, then, in the majority of cases, the temperature does not sensibly vary until all the water is frozen; the solution yields up the salt in the solid form as fast as the water freezes, so that the concentration of the solution remains throughout unchanged. The temperature marked by the thermometer under these circumstances *is the freezing-point of the solution normally saturated with the salt that separates.*

The following table contains part of the results of my experiments on the temperature of congelation of solutions of sodic sulphate. A single asterisk attached to the numbers in the first column indicates that the solution is “supersaturated”[||] with Glauber's salt, $Na_2SO_4,10H_2O$; a double asterisk indicates that the solution is supersaturated with the seven-atom hydrate, $Na_2SO_4,7H_2O$. The numbers printed in larger type refer to the normally *saturated* solutions of $Na_2SO_4,10H_2O$ and $Na_2SO_4,7H_2O$.

Weight of anhydrous sodic sulphate in 100 of water.	Freezing-point. °C.
2·00	−0·60
4·00	−1·20
5·00*	−1·40
6·10*	−1·70
10·00*	−2·75
12·20*	−3·05
14·50*	−3·55
15·00**	−3·65
20·00**	−4·50

It will be seen from the foregoing table that the normally-saturated solution of Glauber's salt freezes at −1·2° C. (29·8° F.),[*] and the normally saturated solution of the seven-atom hydrate at −3·55° C. (25·6° F.); the first contains 4·0, the second 14·5 parts, of anhydrous sodic sulphate to 100 of water.

The solution containing 20 parts of anhydrous salt to 100 of water (0·608 of Glauber's salt to 1 of water) freezes at −4·5° C. (23·9° F.). It is exceedingly difficult to make this solution freeze without depositing crystals of the seven- or ten-atom hydrates; I succeeded only once, after more than twenty trials. Almost as soon as the ice begins to form, the seven-atom salt is generally thrown down suddenly, the solution becomes normally saturated with this hydrate, and the temperature rises to −3·55° C. (25·6° F.). If later the crystallisation of the ordinary ten-atom salt sets in, the thermometer does not stop at −1·2 C. freezing-point of the saturated solution of this hydrate), but very often rises far beyond. The reason of this is, that in such strong solutions the greater part of the water is required to form the ten-atom hydrate, and but little is left to form ice. But when the solution is less concentrated—when it contains, say, 5 or 6 parts of anhydrous salt to 100 of water—as soon as the crystallisation of the ten-atom hydrate sets in (the congelation having previously begun) the temperature rises from −1·4° or −1·7° C. (see the Table) to (very nearly) −1·2° C., and there remains stationary until almost all the water is frozen.

The ice which separates from a concentrated saline solution is always more or less charged with salt, which, being deprived of its solvent, is forced to separate in the solid state. The appearance of the ice formed, under different circumstances, in one and the same solution often varies greatly, according to the greater or less quantity of salt with which it is mixed. If the quantity of the latter is large, the ice is opaque white or coloured, according to the nature of the salt;[†] the smaller the quantity of salt, the more the ice resembles that formed in pure water. When the solution is gently agitated during the congelation, and the temperature of the freezing mixture is not too low, the greater part of the salt, as it separates, falls to the bottom of the vessel, while the ice, being lighter than the solution, all rises to the surface of the liquid. The more dilute the solution, and the more slowly and carefully the experiment is conducted, the smaller the quantity of salt found in the ice when this is taken out and melted.

The reader will now readily understand why the temperature of Mr. Tomlinson's solutions always rose to 26° F. as soon as the “new hydrate” began to form. The reason is that *26° F. (or 25·6° F.) is the freezing temperature of the saturated solution of* $Na_2SO_4,7H_2O$, and that all the solutions in Mr. Tomlinson's experiments had thrown down some of this hydrate.[‡]

If Mr. Tomlinson, when he repeats his experiments, will avoid using a freezing mixture at a temperature lower than −6° C. (21° F.), and keep the solution continuously, though gently, agitated, so that the temperature be uniform throughout the liquid, he will find—

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[*] I will add that the temperature at which M. Violette observed the formation of the crystals “en choux-fleurs” was about −4° C. (24·8° F.); they proved to be lighter than the solution, for when detached by agitation from the sides and bottom of the vessel, they rose to the surface of the liquid.

[†] My first paper on this subject has been published in the *Annales de Chimie et de Physique*, 4me série, t. xxiii., p. 366.

[‡] Rüdorff is the author of the only satisfactory method known for determining with accuracy the freezing temperature of a saline solution. I have shown (*loc. cit.*, p. 403) how this method can be made applicable to supersaturated solutions.

[||] When I speak of a solution as being *supersaturated* with a certain salt at a given temperature, I only mean that it is more concentrated than the *saturated* solution of the same salt at the same temperature. I make no hypothesis as to the condition of the salt *in* the solution.

[*] I believe all the temperatures in the table to be exact within less than 5-100ths of a degree.

[†] See, on this subject, the very interesting experiments by Rüdorff in Poggendorff's *Annalen*, Bd. 116.

[‡] Mr. Tomlinson says that in his first experiment, with a solution of 1 part of Glauber's salt to 1 of water, the formation of the “new hydrate,” which began at 19° F. (−7·2° C.), caused the temperature to rise to 26° F. When the flask was transferred to water at 48°, “the opaque white crystals broke up into an amorphous woolly mass. As the temperature of the solution rose to 40°, then for the first time the usual transparent octahedra of the anhydrous salt fell down.” In this there must be some mistake. The freezing-point of the solution of 1 part of Glauber's salt to 1 of water (28·3 of anhydrous salt to 100 of water) is certainly below 23° F. (−5° C.). If, therefore, the temperature rose to 26° F., and there remained stationary, it must be that crystals of the seven-atom hydrate were present in the solution. The “transparent octahedra of the anhydrous salt” are, as I shall presently show, not crystals of the anhydrous salt, but of the seven-atom hydrate. Mr. Tomlinson first observed them when the temperature had been raised and the ice melted; but they must have been thrown down before this, or the temperature during the congelation could not have risen to 26° F.

(1). That under no circumstances can the supposed "hydrate" be made to crystallise at a temperature higher than 26° F.

(2). That where a certain quantity of this "hydrate" has formed, the whole of it will in time disappear if the temperature of the solution is raised ever so little above 26° F.

(3). That the transparent crystals at the bottom of the flask will not become "opaque white,"* and the "hydrate" will not adhere to the bottom of the flask; but, as fast as it forms, it will rise to the surface of the liquid. In the meantime, the quantity of seven-atom salt will go on constantly increasing, and the greater part of it will collect at the bottom of the flask; the thermometer will mark steadily 25·6° F. (within one-tenth of a degree) until the layer of floating ice meets the layer of salt at the bottom, and the whole mass is nearly solidified. Then only will the temperature begin to fall below 25·6° F.

Before closing I must call attention to an error which occurs in several of Mr. Tomlinson's papers.

When a supersaturated solution of sodic sulphate is cooled to a sufficiently low temperature, it throws down transparent crystals resembling octahedra. Mr. Tomlinson always describes them as crystals of the *anhydrous* salt, whereas in reality, they are crystals of the *seven-atom hydrate*. The salt, $Na_2SO_4,7H_2O$, crystallises in rhombic prisms, $\infty P . \infty \bar{P}3 . \infty \breve{P} \infty$, terminated by $\breve{P} \infty . \frac{1}{3} \breve{P} \infty$.† The angles, $\infty P : \infty P$ (macr.) = 87° 20′, and $\breve{P} \infty : \breve{P} \infty$ (basal) = 88° 0′, so that when, as very often happens, the faces, $\breve{P} \infty$, are sufficiently developed, the crystals assume the appearance of quadratic pyramids with truncated summits ($\infty \breve{P} \infty$).‡ The crystals of $Na_2SO_4,7H_2O$, which are thrown down suddenly have generally this pyramidal or octahedral appearance; but I have often seen prismatic and pyramidal crystals thrown down together, and I have seen pyramidal crystals, as they grew larger, assume the prismatic shape. Both pyramids and prisms become opaque white when touched with the ten-atom salt, and in every other respect their properties are identical.

The crystals of anhydrous sodic sulphate which form in hot solutions when these are evaporated are rhombic octahedrons; but they do not in the least resemble the octahedral-looking crystals of the seven-atom hydrate. All those I have seen were turbid, never transparent.

There are two distinct varieties of anhydrous sodic sulphate, both of which can exist at temperatures below 33° C. One of these modifications is several times more soluble than the other. When the less soluble anhydrous sodic sulphate is heated to above 33° C. it is transformed into the more soluble modification.|| Both varieties combine with cold water, the less soluble one forming the ordinary ten-atom or Glauber's salt. From some of Löwel's observations, it would appear that below 18° C. the more soluble modification in contact with water is gradually transformed into the seven-atom hydrate. I have not yet been able to determine the composition of the hydrate formed by the more soluble modification between 18° and 40° C. Above 25° C. it cannot be the seven-atom hydrate, for Löwel has shown that this salt is destroyed at that temperature. The quantity of water taken up between 18° and 40° C. seems to vary with the temperature, the relative quantities of salt and water, and the length of time they are left in contact.

The two varieties of anhydrous sodic sulphate and the ten- and seven-atom hydrates are the only well-defined modifications of sodic sulphate which have yet been discovered.

Paris, March 6, 1872.

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* Unless, of course, crystallisation of the ten-atom salt sets in. As is well known, crystals of the seven-atom hydrate become opaque when touched by the ten-atom salt.

† Watts's "Dictionary of Chemistry," vol. v., p. 612.

‡ Compare Fig. 267 in Watts's "Dictionary of Chemistry," vol. ii., p. 147.

|| See CHEMICAL NEWS, vol. xxiii., p. 266.

THE ESTIMATION OF COMBINED CARBONIC ACID IN WATER.*

By EDWARD NICHOLSON,
Analyst of Waters, Mysore, Northern, and Ceded Districts.

A PRACTICALLY easy process for the estimation of the carbonic acid existing in water as carbonate or bicarbonate being most desirable, I have lately begun examining the processes which seemed most likely to be of use. Amongst others, I have examined a process quoted in Dr. Parkes's "Manual of Hygiene." It is a volumetrical process devised by M. Lory, and its performance is thus described:—

"(1). Precipitate copper phosphate from the bichloride by sodium phosphate. Wash precipitate, suspend in water, and dissolve in slight excess of HCl, adding the acid drop by drop.

"(2). Dissolve 0·265 grms. of pure dry sodium carbonate in 1 litre of water for a test solution, and pass through it a current of CO_2.

"(3). Take 100 c.c. of the test solution, and drop in the copper solution until the cloud first formed is re-dissolved. Read off amount of copper solution used, and dilute if necessary, so that the 100 c.c. of test solution shall exactly take 4·4 c.c. of the copper solution. In testing water take 100 c.c. and seize the exact moment of the disappearance of the cloud. Read off the amount of copper solution used, and calculate as follows:—1 c.c. = 0·006 of sodium carbonate or 0·00566 of calcium carbonate. To find the CO_2, multiply the c.c. used for 100 c.c. of water by 0·5; the result is centigrammes of CO_2 per litre existing as bicarbonate."

On examining the reaction, it is evident that the phosphate of copper has little or nothing to do with it. This substance dissolves in hydrochloric acid without alteration, and on the solution being dropped into any fluid of alkaline reaction, the phosphate of copper precipitates by the withdrawal of the free acid which held it up. If more of the acid solution is added, the precipitate increases until the fluid becomes neutral, and then an excess will gradually take up again the precipitated phosphate of copper. This is necessarily anything but a sharply defined action, for the acid solution, if prepared as directed, is already nearly saturated with phosphate of copper, and requires to be added in considerable excess after the fluid under examination has become neutral. Using such a solution, I found that whereas 1·0 c.c. neutralised a certain quantity of alkaline fluid, no less than 2·0 c.c. were required before the cloud began to clear away perceptibly, and above 3·0 were required to produce complete re-solution of the precipitate. With a solution containing about twice as much acid as was requisite to dissolve the phosphate of copper, the reaction was much more distinctly shown, but still a considerable excess had to be added after perfect neutralisation of the alkaline fluid; whilst acid reaction was shown by litmus-paper at 1·0 c.c., at least 1·4 c.c. had to be used in order to remove the turbidity. The phosphate of copper not entering into the alkalimetrical reaction is merely a substitute for tincture of litmus and not a good substitute nor a well applied one, as the solution is really analogous to standard sulphuric acid coloured by litmus. Now, no one would think of using litmus in that way, and yet this is all the novelty in the process, a substitution of dilute hydrochloric acid coloured by phosphate of copper for dilute sulphuric acid coloured by litmus. I tried using the saturated solution in the same way as tincture of litmus, adding a few drops as a preliminary to ordinary volumetrical estimation by a standard solution of sulphuric or oxalic acid; the excess of acid used to re-dissolve the precipitate at the end of the reaction being equal to that originally introduced along with the phosphate of copper, no correction being necessary. This is the best way of using the phosphate of copper; but I cannot see any advantage

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* From the *Madras Monthly Journal of Medical Science* for October, 1871.

in it over tincture of litmus, and the end of the reaction is not nearly so exactly shown as it is by litmus-paper. Using a dilute solution of sulphuric or oxalic acid, and testing the progress of the reaction by touching sensitive litmus-paper with the glass stirring-rod, great precision is attainable, alkalinity being readily estimated to 1 milligramme of carbonate of soda per litre of water.

M. Lory's process is a disadvantageous modification of the ordinary alkalimetry; it has also nothing to do with carbonic acid except in an indirect manner, any solution of alkaline reaction giving similar results whether it contains caustic alkali, a carbonate, a bicarbonate, a silicate, a phosphate, or a borate, or even a mixture of two or more of these salts.

Now, natural waters contain silicates just as often as carbonates, and sometimes in quite as large amount; alkalimetrical processes applied to them will then give the amount of bases combined with silicic and carbonic acids. If silicic acid combined with bases in as simple proportions as carbonic acid does, there would be no difficulty in obtaining the amount of carbonate by deducting the amount of silicate corresponding to the silica as determined by weight. Unfortunately, silicic acid combines in so many different proportions that it is exceedingly difficult to deduce from the weight of the silica how much base it was combined with.

The direct determination of carbonic acid is a matter of no small difficulty. The only courses open at present are—

(1). Precipitation of carbonic and silicic acids together by lime-water or ammoniacal chloride of barium, and estimation of the carbonic acid in the precipitate; this estimation may be done in two ways—either directly, by determining the loss of weight on decomposition by a strong acid in one of the light flasks usually employed for this purpose, or indirectly by conversion of the precipitate into sulphate and calculation of the carbonic acid.

(2). Extraction of the carbonic acid and direct measurement in the gaseous state. This is the most exact course to follow, as it can be divided into two estimations—that of the gas which is free or is present as the second equivalent of acid in the bicarbonates, yielded by simple ebullition; and that of the carbonic acid retained by the carbonates, yielded on further ebullition after addition of a strong acid. The apparatus required is, however, rather complicated, and so much care and time are required that this method can only be carried out in a well-appointed laboratory.

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

XV.

If, as already explained, we place between the light and the slit of the spectroscope a layer of coloured fluid, a phenomenon known as absorption takes place; this is different, not only for differently coloured bodies, but for similarly coloured bodies from different sources; so varied are these appearances that individual bodies can be immediately recognised. Animal fluids and colouring matters may thus be identified.

Blood may be taken as a type of absorption-bands; a dilute solution in water gives in the yellow, about the position of the sodium or D line, a band, and another one immediately on the green, and cuts off the violet end of the spectrum.

Chemical changes in the constitution of bodies may be seen with this instrument. Arterial blood, as described above, giving two bands, may be reduced by H_2S or the alkaline tartrate of iron, and then the two bands become merged into one large broad one. This is exceedingly interesting to the physiologist, because it affords an explanation of the process of respiration as it takes place in the lungs.

If the ear of any albino, say a young white rabbit, be interposed between the spectroscope and a strong light (Drummond's), the first, or oxygenated spectrum may be seen; if, while under observation, the animal be suffocated with CO_2, the second, or venous spectrum, will then be seen.

The spectroscope also determines how certain poisons act; thus CO, H_2S, HCN, and others combine with the blood and produce new spectra, proving that it is not the absence of oxygen, *i.e.*, suffocation, that is the cause of death.

By the micro-spectroscope a corpuscle may be analysed with as much certainty as a larger quantity. The bile gives a definite spectrum, especially when treated with Pettenkofer's test; the cholochrome and the biliary acids are capable of differentiation. The urochrome, or colouring matter of the urine, which, as previously described, may be converted into several compounds, is readily recognised, as are the derivatives. To fluids supposed to contain these things the application of the spectroscope at once settles the question, as, for instance, blood in urine.

The vegetable world gives very characteristic spectra in the very many compounds it produces, a most beautiful and interesting one being derived from chlorophyll or leaf-green extracted by alcohol from any green vegetable matter. The anilines also afford a variety of spectra.

From the numerous spectra that occur in nature it is not difficult to imagine that of necessity some two or three must resemble one another, if not identically, yet so closely that mistakes may easily be made. Thus blood and the extract of alkanet root are very similar, requiring for their distinction a great dispersion and good measuring capacity.

The whole subject is yet in its infancy. Though much has been done by many able workers, a vast field of inquiry remains still untouched; and I doubt not that this instrument will assume, before long, as much importance in the hands of the physician and surgeon as the microscope does at the present time.

These very brief and superficial statements profess no more than to call attention to a subject much neglected, and to direct the inquirer's mind to the proper path whereby greater facts may be elucidated.

NOTE ON THE DIGESTION OF MINERAL SUBSTANCES.

By RICHARD V. TUSON, F.C.S.,
Professor of Chemistry at the Royal Veterinary College.

Physiologists and chemists have hitherto entertained the belief that the principal if not the sole function of the pepsin and acid contained in the gastric juice is to render soluble the albuminoid constituents of food, and thus prepare them for the subsequent process of absorption.

Conceiving, however, that it would be extremely interesting to study the effect, if any, of the solvent constituents of the gastric juice upon mineral substances, especially those employed as medicines, I have set myself the task of investigating this subject. The inquiry is as yet but in its infancy; nevertheless the results already obtained are sufficiently positive and striking to induce me to "claim date" by placing on record the following experiments:—

Expt. 1.—A mixture of calomel* and distilled water containing 2 per cent of hydrochloric acid.

Expt. 2.—A mixture of calomel, pepsin,† and distilled water.

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* The calomel employed in all the experiments was previously tested as to its purity.

† *Pepsina porci* prepared by Messrs. Bullock and Reynolds.

Expt. 3.—A mixture of calomel, pepsin, and distilled water containing 2 per cent of hydrochloric acid.

These mixtures were placed in glass vessels, and kept at 38° C. (100·2° F.), *i.e.* about the temperature of the body, for twenty-four hours, during which time they were occasionally stirred or shaken. They were then thrown on to filters of Swedish paper, and the filtrates saturated with hydrosulphuric acid.

The filtrate from experiment 1 remained unaltered.
" " 2 " "
" " 3 yielded a black precipitate of sulphide of mercury.

The results of these experiments, therefore, show that neither dilute hydrochloric acid (2 per cent) nor pepsin alone is capable of dissolving calomel, but that when these agents are mixed they do effect its solution, and, consequently, that the digestion of calomel, so far as its solution in artificial gastric juice is concerned, is brought about under the same conditions as that of the albuminoids.

The importance of this observation will become apparent when it is borne in mind that it offers an additional explanation to those already published of the manner in which calomel enters the circulation, in order that it may exercise the many therapeutic actions with which it is accredited.

Whether or not oxide of antimony, sulphide of antimony, and other so-called insoluble remedies are dissolved by pepsin and dilute acid, is a problem which yet remains to be solved.

The influence of different acids, the chemical characters of the dissolved mineral and its behaviour when subjected to dialysis, and the action, if any, of peptones on inorganic bodies, have also to be determined, but these matters, together with many others, will form the subject of future communications.—*Lancet.*

THE SPECTRA OF MANGANESE IN BLOWPIPE BEADS.

By CHARLES HORNER.

Manganese may be readily detected in most minute quantities by its spectra in blowpipe beads. The following is the best method of preparing them:—Sufficient chlorate of potash should be volatilised in the loop of platinum wire to form a bead about the size of a pin's head, then take up the merest trace of the oxide and fuse it; next add enough chlorate to fill the loop, and very gently flame the bead for a few seconds and withdraw, when it crystallises a delicate pink colour. In adding the second portion of chlorate care must be observed not to volatilise the salt, and the best result is when the bead does not much exceed the thickness of the wire. If after adding the second portion we volatilise the chlorate, we immediately obtain a greenish coloured bead of manganate of potash, and more transparent than the pink bead.

In order to see the spectra of these beads, they should be examined by the spectrum microscope and strongly illuminated. The pink bead exhibits several absorption-bands more or less definite according to the amount of manganese present. The three most distinct bands, however, lie between D and *b*, and may be seen when the bead is scarcely coloured. This spectrum very closely resembles that given by the crystals of perchlorate coloured by permanganate of potash, but the bands are slightly more refrangible in the former. The green bead gives a spectrum of two bands, one broad band covering the sodium line, and a very narrow band in the orange ray. This spectrum test is most useful in the examination of minerals, for although the pink colour is sometimes disguised by the presence of other substances, as in rhodonite, which communicates a yellowish tint to the bead, yet the three principal absorption-bands are plainly visible.

METALLIC MANGANESE.

By J. ENEU LOUGHLIN, M.D.

The preparation of metallic manganese has been effected in a variety of ways; the most convenient methods are those requiring crucible operations.

Gahn first succeeded in obtaining the metal from peroxide of manganese by mixing it with charcoal and oil, forming the mass into pellets, which were introduced into a brasqued crucible and heated for three-fourths of an hour in a forge.

Silliman, in his "Elements of Chemistry," vol. ii., p. 174, states, "Faraday obtained metallic manganese by simply heating the tartrate alone, and by passing hydrogen gas over the heated oxide."

With a view of obtaining metallic manganese in a pure condition, I have examined,

1st. *The Process of Deville*—heating pure manganese oxide with about 1-10th its weight of sugar charcoal in a lime crucible, placed in a brasqued crucible; heating for three hours at a dull white-heat. The product obtained was of a brownish colour, very brittle, possessed a sp. gr. of 7·95, was violently acted upon by sulphuric acid with disengagement of hydrogen gas; the powdered mass scarcely decomposed water at 200° F., but upon re-heating and powdering the mass, decomposition of water was slowly effected at 150° F., and the sp. gr. of the mass rose from 7·95° to 7·98°. The metal obtained by this process was extremely brittle, with a brownish-red lustre; viewed with a lens it had the appearance of being composed of many small nodules aggregated. This method yields very good results. The lime crucible might be replaced advantageously by one of porcelain.

2nd. *The Method of Brunner*, involving the employment of metallic sodium, did not succeed well in my hands, the only compensation received for a vast amount of labour being 5 grains of a metal possessing great hardness, sp. gr. 7·20, and a lustre resembling white cast-iron.

The two following are those from which I have derived the best results:—

(1). 50 grs. pure oxide of manganese, prepared from carbonate of manganese, was mixed with 25 grs. of cyanide of potassium and 15 grs. of animal charcoal, placed in a small porcelain crucible, which was introduced into a brasqued crucible and kept at a dull white-heat for two hours; the crucible being removed, was found to contain a dark, almost black, mass loosely aggregated, presenting several metallic points; sp. gr. 7·94. The whole mass was then powdered, slightly washed with ice-cold water, mixed with powdered animal charcoal, and heated for two hours at a dull white-heat; a very brittle mass was obtained of a sp. gr. 7·99, brownish-black lustre, decomposing water very slowly at 100° F., easily acted upon by sulphuric acid, and presenting no marks of crystallisation.

(2). 50 grs. of peroxide of manganese, mixed with 100 grs. of powdered charcoal, were made into a paste with castor-oil, divided into small *balls*, introduced into a porcelain crucible contained in a brasqued crucible, and kept for one hour at a dull white-heat. The mass obtained was of a brown, almost black colour, loosely aggregated, and of a sp. gr. 7·84. The mass was well powdered, mixed with charcoal, and re-heated for two hours at a dull white-heat. The mass obtained was still very dark, of a cast-iron appearance, more aggregated than previously, and of a sp. gr. 7·96, an increase of 0·12.

The mass was again mixed with charcoal and heated for 1½ hours at a dull white-heat, when the mass was found to have changed in colour to a brownish-red, with a lustre resembling that of dulled bismuth—to have become quite brittle; sp. gr. 7·98 an increase of 0·02. This product, not being as compact as desirable, was mixed with 10 grs. of borax and 5 grs. of charcoal, and heated for two hours at a white-heat, when a fine compact mass was obtained, showing evident marks of fusion upon the edges; colour resembling that of bismuth, showing upon fracture an appearance like cast-iron; sp. gr. 7·993, an increase of 0·013; scarcely tarnished in dry air; in moist air tarnishing readily, becoming covered with a dark brown powder; violently acted upon by sulphuric acid with disengagement of hydrogen gas, and effecting decomposition of water slowly at 100° F., energetically at 212° F.

From the above carefully recorded experiments I think we are warranted in asserting that the task of producing perfectly pure manganese is one of great difficulty. Indeed, the discrepancy between the specific gravities, ranging from 6·85 to 8·015 as given by different experimenters, leads us to suppose that we are dealing either with manganese under vastly different molecular forms; or, that many chemists have been duped into considering a compound of manganese with manganese indifferently oxidised as metallic manganese proper, and assigning to it certain definite metallic characteristics.

From my experiments upon the mass produced by process No. 2, a mass possessing a sp. gr. of 7·84 raised by successive heatings through the numbers 7·96, 7·98, 7·993, with like physical and chemical changes, I am led to consider the mass with a sp. gr. 7·84 as representing a compound of metallic manganese with manganese more or less oxidised, constituting for the time being, a veritable chemical compound, susceptible of decomposition under the influence of heat and carbon. This compound, under the influence of the decomposition by heat and carbon, passes through progressively decreasing stages of oxidation and progressively increasing stages of metallisation. There are also reasons for supposing that manganese may exist under various molecular conditions; under any other hypothesis it would be difficult to allow the existence of a metallic manganese of sp. gr. 7·13 as prepared by Brünner, and one of sp. gr. 8·015 as prepared by Deville; *both* presenting certain well-marked physical and chemical characters.—*American Chemist.*

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Ordinary Meeting, Monday, March 11th, 1872.

Dr. William Wallace, F.R.S.E., President, in the Chair.

"*On some Experiments with the Fehling's Copper Solution,*" by Dr. T. L. Patterson. This paper, and the discussion which followed, will be inserted in our next issue.

"*On Recent Views regarding the Composition of Ultramarine,*" by E. M. Dixon, B.Sc.

The object of this paper was to bring under the notice of the members the views advocated by Stein respecting the constitution of ultramarine. Stein's papers were characterised as interesting both to chemists and physicists, inasmuch as they contain tolerably cogent reasoning in favour of an unusual view of the chemical composition of ultramarine, and as they refer the well-known colour of that body to causes previously known to physicists but probably never recognised as present in it. To prepare the way for a discussion of Stein's views, the author of the paper briefly summarised the leading steps in the manufacture of green and blue ultramarine, and then proceeded to state the general character of the discussions that have from time to time taken place during the last forty years respecting the composition of blue ultramarine specially. The supposition that the sulphur is combined only with sodium was said to be a general characteristic of these discussions. The various views enunciated by different investigators were said to differ from each other on two points:—(1) Which sulphur-acids are combined with sodium? (2) The mode in which silica is combined with alumina and soda. Of these views two were referred to as having been the subject of research about twelve years ago in the Giessen laboratory under the direction of Professor Will, and the decision in favour of one of them was stated to have had, in all probability, some influence in arresting further discussion until the appearance last year of Stein's papers.

In the account given of Stein's researches the author expressed his belief that the facts adduced by Stein disproved the generally entertained views as to the presence either of polysulphide of sodium, or of monosulphide and hyposulphite of sodium in blue ultramarine. The arguments advanced to show that sulphide of sodium cannot be the cause of the blue colour were briefly referred to, and the hypothesis that the colour is due to the presence of small molecules of black sulphide of aluminium enclosed in correspondingly small and thin envelopes of a double silicate of soda and alumina was stated as being the essential point in Stein's views. The author shortly criticised the said hypothesis, and, while considering it as worthy of serious attention at the hands of chemists and physicists, expressed his impression respecting the want of evidence with respect to the state—free or combined—in which the sulphide of aluminium exists. The paper concluded with an account of a subsequent research of Stein's in which it is proved to the satisfaction of the author, that in cobalt-ultramarine the oxide of cobalt present is one of the oxides of that metal known to be *per se* a black neutral body. This fact is adduced by Stein to show that, in all probability, cobalt-ultramarine owes its blue colour to its having a physical structure similar to that attributed by him to ordinary ultramarine.

The President, in opening the discussion, said Mr. Dixon's paper had the charm of novelty about it, but he was not prepared to admit the truth of the hypothesis advanced by Stein regarding the colour of ultramarine.

Dr. Clark suggested that the colour was possibly due to the existence in ultramarine of some of the blue variety of sulphur which is sometimes found when that element is precipitated in very minute subdivision.

Mr. Patterson referred to Tyndall's experiments on light, and stated that Dr. Clark's blue sulphur was probably only another illustration, along with ultramarine, of the effect of exceeding fine division of certain varieties of matter reflecting only blue rays.

Mr. Sutherland, in order to show that Stein's hypothesis was not satisfactory in respect of the coating of silicate of alumina and soda spoken of by Mr. Dixon, inasmuch as while boiling caustic soda dissolves alkaline silicates, that is no effect on ultramarine.

CORRESPONDENCE.

WATER ANALYSIS.

To the Editor of the Chemical News.

Sir,—I desire to express my gratitude to Mr. Nicholson for so candidly withdrawing his adverse statement respecting the ammonia process. Others, besides Mr. Nicholson, have, before now, reported unfavourably, but he alone has made an honourable retreat.

Some of those who formerly reported against the process are sometimes described as the most distinguished chemists in this country. Dr. Frankland, for instance, who described himself, officially, as unable to make it work. (Does he use Government apparatus? Possibly he does, and possibly his having also discovered five abortive methods of generating hydrogen is to be set down to that score). Dr. Odling, who joined Dr. Frankland in the report to the Government against the ammonia process, appears to have retreated from his position—satisfactorily, however, I cannot say—inasmuch as whilst practically admitting the validity of our method by working it in his laboratory, he has refrained from withdrawing his share of the conjoint condemnation which he and Dr. Frankland furnished to Government. I think it right, from time to time, to call attention to facts of this description, in order that the rising generation of chemists may know what to expect from those who at present occupy prominent positions in this country.—I am, &c.,

J. Alfred Wanklyn,

London, March 16, 1872.

MISCELLANEOUS.

Atmospheric Poisoning of Houses by Arsenical Wall Coverings.—There is one question closely connected with the sanitary condition of dwelling-houses, which has hitherto been unaccountably neglected by those in charge of the public health, and that is, How are our walls covered? With paper, paint, and distemper wash, containing the deadly and volatile poison of arsenic, which is continually giving off poison in the form of an impalpable dust, and also of arseniuretted hydrogen, which is gaseous at the usual temperature of the air. The fact that nearly all the green colouring now in use is arsenical has been indisputably proved by eminent analysts. Specimens can be produced of pale green papers containing 6, 9, and even 14 grs. of arsenic to the square foot, and papers containing only a leaf or line of green in the pattern are arsenical and injurious. Yet such papers are to be seen everywhere; in royal palaces, in the mansions of our nobles and gentry, in lodging houses, and in the homes of the middle and industrial classes in town and country. Medical men have these poisonous papers on their walls, and suffer from them unawares. Arsenic was first employed in the manufacture of wall-papers about the beginning of this century, and its use has been on the increase year after year up to the present time. If we cover our walls with a poison which is not only deadly but volatile, can we wonder at deterioration of health and of race? The writer's experience of the danger of arsenical wall-papers extends over a period of fourteen years, during which an entire household, numbering fourteen persons, suffered severely. Many physicians were consulted, but the symptoms baffled them all. The writer's eyes were at last opened by reading "The Green of the Period" (Routledge), and analysis proved that every paper in the house which contained a speck of green was arsenical: these were at once removed, and a Turkish bath put up in the house, by using which daily, symptoms threatening fatal results were quickly relieved. But now follows an important point, proving that arsenic is not confined to green colouring as supposed, but is used in papers of all colours, and even in white. Our papers containing green were replaced with others totally devoid of green, but in a few months' time many alarming symptoms reappeared. Suspecting arsenic again, all these papers were analysed, and arsenic was found in the paper of every bedroom in the house, though not one contained even a speck of green. On removing these papers, and colouring the walls with whiting and size, tinted with safe colours, relief soon followed, and health has since steadily improved. (Further details are given in two articles contributed to the *British Medical Journal*). It often happens that dangerous arsenic papers are concealed underneath harmless ones, owing to the pernicious custom of putting one paper over another. A very severe case of poisoning by this means has recently come under my notice. Many of the pigments now in use appear to contain arsenic; therefore, in substituting paint or wash for paper, it is important to know of what the colours are composed. There is a "new blue" used for colouring walls, which contains arsenic, and the green distemper wash so often used instead of paint is almost invariably arsenical; being totally unglazed, it is all the more rapidly injurious. But the gaseous exhalations of arsenic have been found dangerous, both from glazed papers and oil paint, as was proved at Munich in 1860. The Prussian Government, recognising the danger, "forbid the use of arsenic in any colours, whether distemper or oil, for indoor work." Yet in this country arsenic paint is freely used on the walls of our rooms, and on Venetian blinds; the green paint used for these latter articles containing about 75 per cent of arsenic. Of what use, comparatively speaking, are restrictions on the sale of arsenic by druggists, when painters and paper-makers can purchase it in unlimited quantities, using it by tons weekly for wall-papers, and thus poisoning the population wholesale? Legislation in this matter is urgently called for, to make penal the use of arsenic in any form in the interiors of houses, and to provide legal protection and compensation for the victims of this iniquitous mode of poisoning, the existence of which, unchecked, is a disgrace to our Government. There is also another question to be dealt with—How to get rid of all the arsenic now on our walls, which, without doubt, is permanently injuring the health of the present and rising generation, and through them future generations? How can anything but deterioration of race result from living, and bringing up children, in atmospheres where every breath that is drawn conveys a deadly poison into the blood? The cerebral symptoms produced by arsenic are peculiarly deserving of attention, and offer a wide field for investigation to physicians who devote themselves to the study of diseases of the brain and nervous system. Fevers and eruptive diseases appear to result not unfrequently from this mode of blood-poisoning, and who can say how much of epidemic disease and mortality therefrom may not be in a great measure due to this cause, by predisposing the system for its reception, and by the prostration of strength which would tend to induce fatal results in attacks not of themselves dangerous. I would conclude by drawing special attention to the bearing of the whole subject on the expected visitation of cholera; one marked effect of arsenic being to produce choleraic diarrhœa and other symptoms akin to that disease.—*Abstract from the "Transactions" of the Social Science Association*, 1871.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, March 4, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Absorption Spectra of Chlorine and of Chloride of Iodine.—D. Gernez.

Crystallised or Burnt Iron.—H. Caron.—This essay contains the detailed account of the results of a series of experiments made with malleable iron of good quality, for the purpose of ascertaining the effects of very high temperatures upon that metal for the purpose of obtaining burnt iron, and to detect what the precise change is which is thus produced; it also contains the results of experiments at very low temperatures in order to produce the crystalline state of iron, and to see whether such iron is or is not more liable to fracture. It appears from the author's researches that, as regards burnt iron, it is produced as much by exposing the metal to very high temperatures in oxidising, as in reducing and quite inert, atmospheres; and the deterioration of the metal appears to be due not to the absorption of any particular gas, but to the action of the heat, which modifies its molecular constitution. As regards the action of great cold (some of the bar iron has been kept for more than four consecutive months at temperatures varying from 0° to $-18°$ and $-20°$ in the frigorific works of Ch. Tellier at Auteuil), none of the iron bars had become crystalline, and their resistance to breaking force as well as other properties were unimpaired.

Acetic Ethers of Dulcite.—G. Bouchardat.—In this lengthy memoir we find the detailed description of the mode of preparation and the properties of the following bodies:—Diacetic dulcite, a solid, crystalline, insipid, and inodorous substance; fusing at 176°; volatile, without leaving a carbonaceous residue, when heated in small quantity at a time upon platinum foil; soluble in tepid water, slightly soluble in alcohol, and insoluble in ether; formula—

$$C_{20}H_{18}O_{16}=C_{12}H_{14}O_{12}+2C_8H_6O_6-2C_8H_6O_6, C_{20}H_{18}O_{16}= \\ =C_{12}H_{14}O_{12}+2C_4H_4O_4-2H_2O_2.$$

Diacetic dulcitane, at the ordinary temperature an oily liquid; soluble in water, alcohol, and ether; formula—

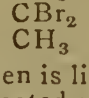
$$C_{20}H_{16}O_{14}=C_{12}H_{14}O_{12}+2C_4H_4O_4-3H_2O_2.$$

Hexacetic dulcite, a solid crystalline substance, fusing at 171°; difficultly soluble in boiling water, but readily so in hot alcohol; formula—

$$C_{36}H_{26}O_{24}=C_{12}H_{14}O_{12}+6C_4H_4O_4-6H_2O_2.$$

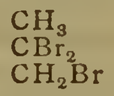
Tetracetic dulcitane, a solid resin-like substance; almost insoluble in cold water, but very soluble in alcohol and ether; formula, $C_{28}H_{20}O_{18}=C_{12}H_{14}O_{12}+4C_4H_4O_4-5H_2O_2$. Pentaceto-monochlorhydric dulcite, an instable crystalline compound. Pentacetic dulcite; the properties of this body are nearly the same as those of the hexacetic dulcite. Acetic acid and dulcite form a large number of neutral compounds, which may be formulated in the following general manner:—$C_{12}H_{14}O_{12}+nC_4H_4O_4-nH_2O_2$ (n can assume in this case any value between 1 and 6), and $C_{12}H_{14}O_{12}+mC_4H_4O_4-(m+1)H_2O_2$ (m can assume for the dulcitane series any value between 1 and 5).

Bromhydrates and Chlorhydrates of Allylen.—Dr. Reboul.—Allylen unites at the ordinary temperature with a very concentrated aqueous solution of bromhydric acid, the result being the formation of dibromhydrate of allylen, a heavy oily liquid, boiling at between 114° and 115°; sp. gr. at 10°=1·875; empiric formula, $C_8H_4,2HBr$; constitutional formula—



$$\begin{array}{l} CH_3 \\ CBr_2 \\ CH_3 \end{array}$$

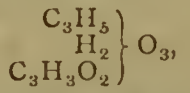
The monobromhydrate of allylen is likewise a liquid, boiling at from 48° to 49°; sp. gr. at 9°=1·39; treated with bromine, this substance is converted into a dibromide—



$$\begin{array}{l} CH_3 \\ CBr_2 \\ CH_2Br \end{array}$$

Allylen also directly unites with hydrochloric acid, whereby two chlorhydrates of allylen are formed, the dichlorhydrate predominating; this latter, when separated by distillation, boils at about from 69° to 70°, and appears to be identical with Dr. Friedel's methyl-chloracetol.

Pyruvine.—Dr. Schlagdenhauffen.—This short paper, as yet only a preliminary notice, contains the intelligence that the author has discovered a glyceride of pyro-uvic acid, by heating glycerine with tartaric acid at a rather high temperature. Analysis proves this body to be composed according to the formula—



$$\left.\begin{array}{r} C_3H_5 \\ H_2 \\ C_3H_3O_2 \end{array}\right\} O_3,$$

that is to say, pyruvine, a solid crystalline body, fusing at 78°; soluble in alcohol, ether, sulphide of carbon, benzine, and especially in chloroform; water dissolves, but at the same time decomposes, it; pyruvine boils at 242°.

Origin of the Aurora Borealis.—Dr. E. H. von Baumhauer.—The author calls attention in this paper to what was published by him in the year 1844 on this subject (in his dissertation "De Ortu Lapidum Meteoricarum," Utrecht, 1844, of which an abstract appeared in 1845 in Poggendorff's *Annalen*, vol. lxv., p. 465); his opinion on the probable origin of the aurora may have been left unnoticed at the time, but has not, at any rate, been controverted on sound scientific grounds, and is well worthy the attention of all interested in this matter.

Reciprocal Action of Acids and Alkaline Bases Separated from each other by a Porous Septum.—E. Landrin.—Notwithstanding the high scientific value of this paper, its contents, elucidated by tabulated forms exhibiting the results of experiments, are not suited for useful abstraction.

Nitrogen Determination in Organic Substances.—L. Kessler.—While adopting the well-known method of Dumas, which the author thinks to be preferable to Will and Varrentrapp's, he substitutes for the graduated glass jar placed over mercury, and intended to collect therein the nitrogen, a caoutchouc bag, wherein some caustic soda solution is first poured, and which is next hermetically connected with the combustion-tube, the bag being kept under water during the time the combustion proceeds; when that operation is finished, the bag is emptied under water, the gas it contains being collected in a graduated glass jar.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 12, 1871.

This number contains the following original memoirs and papers relating to chemistry and collateral sciences:—

Spectra of some Gases as Exhibited in Geissler Tubes.—A. Wüllner.—The continuation and concluding portion of a very lengthy monograph, the contents of which, notwithstanding its very high scientific value, are not suited for abstraction, an observation equally applying to the two following memoirs:—

Law of the Formation of the Lichtenberg Figures.—W. Bezold.

Influence of Astronomical Motion upon Optical Phenomena.—E. Ketteler.

Mineralogical Communications.—G. vom Rath.—Tenth instalment and end of this exhaustive mineralogico-crystallographical monograph, illustrated by a series of engravings.

Mode of Distribution of Electricity over the Discs of Holtz's Electrical Machine, and on an Advantageous Modification in the Construction of the same.—T. Schwedoff.—The contents of this essay could not be understood unless the engravings belonging thereto were reproduced.

Decrease of the Chemical Force of Hydrogen and Carbonic Oxide for the Reduction of Proto-Peroxide of Iron by the Admixture of Foreign or other Gases.—W. Müller.—The contents of this memoir bear on the essays published by Dr. Sainte-Claire Deville some two years ago in the *Comptes Rendus*; the main results of the author's researches may be summarised as follows:—A mixture of iron and of proto-peroxide of that metal, when heated in an atmosphere of steam and hydrogen or of carbonic acid and carbonic oxide, calls forth a constant ratio of the gases which is not afterwards altered by the same (viz., the solid substances); the reaction of the gases, which do not chemically combine as far as can be proved, is a more general phenomenon; the action of different other gases, mixed along with those named, does not simply depend upon their specific gravity, but is also dependent upon, and changed by, the nature of these gases.

Use of Permanganate of Potassa in the Galvanic Battery.—J. H. Koosen.—This lengthy paper contains the record of a series of experiments made for the purpose of testing the applicability of permanganate of potassa solution and the dry salt for exciting galvanic currents; it appears that this salt may be used very advantageously for this purpose, yielding galvanic currents of great strength and durability.

Sounding Flames.—H. Planeth.

Determination of the Horizontal Components of Terrestrial Magnetism by Chemical Means.—Dr. H. Schneebeli.

Electrical Tourbillon.—W. Grüel.—The description of an instrument contrived to exhibit the rotation phenomenon first discovered by Dr. Holtz.

No. 1, 1872.

The original papers and memoirs contained in this number nearly all strictly bear upon mathematico-physical science rather than upon chemistry; we give the translation of the titles of these memoirs—

Essay on the Theory of the Electro-Double Machine.—Dr. J. C. Poggendorff.

Reflection Prism.—J. B. Listing.

Anomalous Dispersion.—A. Kundt.

Essay to Explain the Anomalous Dispersion of Colours.—O. E. Meyer.

Propagation (Fortpflanzung) of Light.—J. J. Muller.

Contribution to the Mechanical Theory of Heat.—R. Clausius.

Experiments made for the Purpose of Determining the Coefficients of Expansion of Metallic Wires at Unequal Degrees of Tension.—G. R. Dahllander.

Algebraico-Crystallographical Essay on some of the Double Salts of the Acetate of Uranium.—Dr. C. Rammelsberg.—Illustrated with woodcuts.

Absorption Rays of Chlorophyll.—L. Schönn.

Chromate of Baryta.—E. Zettnow.—The author describes some salts of chromium and baryta formed by the action of sulphuric acid upon chromate of baryta. One of these salts was found on analysis to give results leading to the formula $BaO,2CrO_3,2HO_2$; in 100 parts, after deducting 1·35 per cent of hygroscopic moisture—Baryta, 39·35; chromic acid, 51·26; water, 9·25. The other salt was found to be pure bichromate of baryta.

Tetronerythrin, a New Organic Pigment.—Dr. Wurm.—A statement was made in 1868 in the *Wiener Jagdzeitung* to the effect that the red warty spot met with above the eyes of the mountain-cock and moor-cock *(Tetrao tetrix)*, when rubbed with a white handkerchief, imparted thereto a beautiful red colour. The author was inclined to disbelieve this, and accordingly made some microscopical and microchemical researches on this subject, the result being that he discovered a pigment which he terms tetronerythrin (from *Tetraon* and *erythros*, mountain-cock red). A very small quantity of this pigment, which is soluble in chloroform, was sent by the author to Dr. J. von Liebig, who states that it is a peculiar substance which has nothing in common with the colouring matter of the blood; it is soluble in ether and sulphide of carbon, not soluble in cold caustic alkaline solutions, and soluble in hot nitric acid, but decomposed simultaneously, leaving a waxy residue.

Observations of Double (Extra) Rainbows.—Dr. G. Schneider.—Illustrated by woodcuts.

Annales des Mines, No. 5, 1871.

This number contains the continuation and end of the very lengthy and exhaustive monograph—

Metallurgy of Silver in Mexico.—P. Laur.—Illustrated by several engraved plates. It appears that the only impediment to a very extensive working of the literally inexhaustible mineral wealth of this large and beautiful country is civil war raging there almost uninterruptedly.

Use of Quick-Lime in Blast-Furnaces, and on the Preparation of it in Hoffmann's Annular Furnace.—L. Gruner.—Illustrated by engravings.

Industry of Bituminous Schists (Slate) of the Autun Basin.—M. Chosson.—This exhaustive monograph, illustrated by a series of engraved plates, contains very valuable information concerning the best methods of utilising bituminous slates, and the preparation of valuable products (paraffin, paraffin oil, lubricating oil, &c.) therefrom.

Les Mondes, February 29, 1872.

Cheap Oxygen; Ammonia Prepared from the Nitrogen of the Air.—Rev. F. Moigno.—The excellent author first briefly refers to a paper published in the Chemical News of Feb. 23 last, "On the Utilisation of Waste Substances in Gas Liquor," by R. F. Smith, and then states that the cyanide of titanium there alluded to will become shortly a substance of great industrial importance, inasmuch as this substance will be used in Tessié du Motay's process, after withdrawing oxygen from the air by means of manganate of soda, to fix the nitrogen of the air, and next to convert this into ammonia by passing hydrogen over it; it appears that the experiments made in this direction have been very successful.

Hydrozincite Discovered at Aronzo (Peru).—Dr. Cossa.—The author states that the deposits of calamine (a zinc ore) at the locality alluded to are often found covered by a white earthy-looking material, which the miners throw away as useless rubbish; on analysing this mineral the author found it to be a pure hydrated carbonate of zinc, a mineral first discovered (or at least recognised as a peculiar mineral) in 1803 by Smithson, who named it hydrozincite; the mineral here alluded to was found on analysis to lead to the formula—

$$3CO_2+8ZnO+6H_2O.$$

March 7, 1872.

Programme of the Prize Essays of the Royal Belgian Academy of Sciences for 1873.—Among the various subjects the following chemical question occurs:—New researches to be made for the purpose of obtaining knowledge on the composition of, as well as on the mutual relation existing between, the albuminoid substances; a gold medal of the value of £24; the essays to be legibly written in Latin, French, or Flemish languages, and to be sent on or before June 1 next, carriage or postage paid, to M. Ad. Quetelet, the Perpetual Secretary of the Academy at Brussels. For 1874—New experiments on uric acid and its derivatives, chiefly for the purpose of settling their chemical structure and synthesis.

Usual Nomenclature of 550 Textile Fibres, and the Indication whence and from what Plants they are Derived, their Use, &c., by Bernardin.—Under the title here translated, the author has edited a work which, according to the review here published, contains a very large amount of very useful information, the more so as it appears that the number of textile fibres actually employed in arts and industry is exceedingly limited as compared with those met with in nature and industrially available.

Secchi's Metereograph.—Rev. Father F. Fauva, S.J.—The author, writing from Manilla, states that the instrument alluded to has been during the last two years employed by him at the observatory of the city alluded to, and has given, in every respect, excellent results.

Importance of Declivity in Arboriculture; Hooibrenk's System.—Dr. Duchesne-Toureau.—The first portion of a memoir, illustrated with woodcuts, which curiously verifies for plants what used to be in former ages often applied in animal physiology, "Ubi stimulus ibi affluxus;" the system, simple as it is, deserves attention on account of its really splendid practical results, also in respect of the hitherto unknown or unnoticed power of man over the vegetable kingdom.

Polytechnisches Journal von Dr. E. M. Dingler, first number for February, 1872.

This number contains the following original and papers memoirs relating to chemistry and collateral sciences:—

Improved Diffusion Apparatus for Obtaining Beet-Root Juice.—E. Robert.—Illustrated by engravings.

Potash Industry at Stassfurt.—T. Becker.—The contents of this exhaustive memoir, elucidated by a series of tabulated forms exhibiting the density and boiling-point of various saline solutions, &c., give a very complete description of the very important industry alluded to.

Application of Sulphur in the Roasting of Silver Ores in the Stetefeldt Furnace.—G. Küstel.—A metallurgical paper, recording the results of some experiments made on the large scale with a peculiarly constructed furnace, previously described and elucidated in the above-named periodical.

Chloralum and its Preparations Considered as Disinfectants.—Dr. A. Fleck.—This paper contains the results of analyses and researches on this subject.

The American Journal of Science and Arts, February, 1872.

This number does not contain any original papers relating o chemistry.

Le Moniteur Scientifique Quesneville, No. 362, February, 1872.

The only original paper relating to physico-chemical science published in this number is—

Studies on Dupuy de Lôme's Air-Balloon.—W. de Fonvielle.—A lengthy essay on this subject.

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics des Sciences et des Arts Appliquées à l'Industrie, No. 5, 1871.

This number does not contain any original papers relating to chemistry, but we call attention to the following very important memoir:—

The Coal Formation of the South of Russia; its Situation, Industrial Importance, and Geologico-Geognostic Bearing.—A. Erbreich.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 229, January, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to the following:—

Report made by M. Tresca on the Hydraulic Apparatus Employed in the Gaité Theatre for the Purpose of Moving and Displacing the Various Portions of the Scenery, as Devised by M. Quéruel.—Illustrated by engravings.

La Revue Scientifique de la France et de l'Etranger, March 2, 1872.

This number does not contain any original papers relating to chemistry, but we mention the titles of the following important memoirs:—

History of the Armies and Arms of War.—Colonel Usquin.—The introduction of a series of very interesting lectures on this subject.

Animal Heat, the Temperature of the Blood, and the Vitalist Theories.—Dr. C. Bernard.

Artificial Production of Organic Calcareous Substances.—Dr. P. Harting.—This paper is illustrated by woodcuts. The eminent *savant* states that the contents of this paper are only a brief summary of a work about to be published by him under the title "Recherches de Morphologie Synthétique sur la Production Artificielle de quelques Formations Calcaires Organiques." Were it not for the necessity of reproducing the excellently executed woodcuts added to this paper, we would have given here a more detailed account of its contents.

Journal für Gasbeleuchtung und Wasserversorgung, No. 2, 1872.

The contents of this number bear strictly upon subjects relating to gas- and water-works' engineering and management.

NOTES AND QUERIES.

Fractional Distillations.—(Reply to H. D.)—Place the bulb a certain distance below the surface of the liquid.

Artificial Pumice.—(Reply to T. D.)—It is probable that either the spodumen-like material often met with in large quantity among the blast-furnace slag is meant, or a similar substance occurring in the worn-out crucibles (pots) of glass-houses.

Colour of Chlorine Gas.—It is usually stated in evening lectures that the colour of chlorine gas is not very distinctly observed by artificial light. If the light of burning magnesium is used, and a piece of white paper placed behind the gas as usual, its greenish colour is very evident.—G. C.

Prussian-Blue and Bichromate of Potash.—(Reply to "Ignoramus")—There exist, according to the different modes of preparation, various modifications of prussian-blue, of which the so-called basic variety is soluble in pure water after the salts with which, owing to its preparation, it is mixed up, have been washed out. It is prepared by carefully adding to an aqueous solution of so-called yellow prussiate of potash (ferrocyanide of potassium) a solution of pure protosulphate of iron, care being taken not to decompose all the ferrocyanide. The bluish-white precipitate thus obtained having been collected, is first exposed on a shallow vessel to the oxidising action of the air, and next thoroughly washed with distilled water until the latter begins to run off blue-coloured, thus proving that all the foreign salts are washed out, and the residue is then soluble in pure water. As to bichromate, some is made in France and Germany, but the great bulk in Scotland.

MEETINGS FOR THE WEEK.

Monday, March 25th.—Medical, 8.
—— London Institution, 4. Prof. John Ella, "On Elementary Music."
—— Royal Geographical, 8.30.
Tuesday, 26th.—Civil Engineers, 8.
Thursday, 28th.—London Institution, 7.30. Musical Lecture.
—— Philosophical Club, 6.
Saturday, 30th.—Chemical, 8. Anniversary.

TO CORRESPONDENTS.

G. C.—The paper was set up from a printed proof; any corrections should, therefore, come from the author.

R. B. W.—The English edition of Wagner's "Chemical Technology," which will shortly be published, will contain an excellent article on the manufacture of chlorate of potash.

R. G.—Our Reports on the quality of gas in London are official, and as far as we know, no fuller ones are published.

R. R.—Morfit's "Treatise on Soaps," published by Trübner and Co., will meet your requirements.

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THE CHEMICAL NEWS.

Vol. XXV. No. 644.

A BILL TO AMEND THE LAW RELATING TO PUBLIC HEALTH.

We have wished long and earnestly to see the present vague and inefficient sanitary laws amended, simplified, and brought into some kind of harmony with the chemical and physiological science of the nineteenth century. We have all along maintained that those manufacturing operations upon which our national prosperity depends might be so carried on as not to prove injurious to national health. We believe that nuisances—be they gaseous, liquid, or solid—might be arrested, not merely without loss, but even with advantage, to their present originators. It was, therefore, with deep interest that we took up this long-promised Bill. We regret to own that, after a careful perusal, we found ourselves disappointed.

In section 33 of the Bill we find a string of regulations, already unfavourably known to the scientific and the sanitary world as the "recommendations of the Rivers' Pollution Commissioners." We cannot say that long acquaintance has rendered them at all less unaccountable. We would ask Mr. Stansfeld and his chemical inspirers on what principle the numerical limits for the various impurities have been adopted? Why, for instance, should 0·03 of "organic nitrogen" be considered as objectionable as 2·00 of "organic carbon?" "Organic nitrogen" is, indeed, a peculiar object of dread; its sanitary equivalent—if we may use the expression—being fixed lower than that of arsenic itself. We are to be permitted to pour into any stream, however small, an unlimited quantity of a liquid containing, in 100,000 parts of water, anything less than 0·05 of metallic arsenic, or 0·066 of the ordinary white arsenic of commerce. Half the quantity of "organic nitrogen" is penal. Why should all metals except calcium, magnesium, potassium, and sodium, be excluded if they exceed 2 parts in 100,000? What is the objection to strontium? Are there no natural springs which contain iron and aluminium in even larger proportions. Why are barium, chromium, lead, and copper, all well-known and formidable poisons, permissible in any amount below 2 parts in 100,000 of water? We have heard it wickedly suggested that any very stringent enactment against lead and copper might act as a veto upon the notorious project for forcing a water supply from the metalliferous regions of Cumberland upon the metropolis.

Again, some nitrogenous organic bodies, such as albumen and gelatine, enter readily into decomposition, and yield products highly offensive. Others, also nitrogenous, are much more permanent, and, even if decomposed, yield no products injurious to public health: we may instance urea. Now to group under one head two bodies so utterly dissimilar in their sanitary bearings as urea and albumen merely because they both contain nitrogen is to violate the fundamental laws of scientific classification. No less illogical is the phrase "organic carbon." It is, indeed, high time that such expressions should be expunged from all sanitary discussions. To adopt and perpetuate them in official documents and Acts of Parliament is a reproach to modern science no less than a misfortune to the nation.

This 33rd clause terminates with a proviso charmingly vague and bewildering.

The Local Government Board to be constituted under the Act may "alter any of the foregoing conditions relating to pollution of liquids by *diminishing their stringency*," and may, even, if they think proper, "add to, or alter such conditions of *increasing* the stringency," provided that such proposed increase shall have been previously submitted to both Houses of Parliament for the space of forty days—a longer time of incubation than is required even for the egg of a goose! What the ultimate state of the law will be after a few of these increases and diminutions of stringency, neither man, angel, nor even Rivers' Pollution Commissioner can foretell.

Turning from sins of commission to those of omission—in which latter the Bill, to do it justice, is equally rich—we notice with regret that the air we breathe is not to be more thoroughly protected from pollution by offensive gases and vapours. A Public Health Act worthy of the name would extend to nitrous vapours, to sulphurous acid, to fluorine, &c., regulations similar to those which the Alkali Act applied to the escape of gaseous hydrochloric acid.

Clause 36 embodies the ordinary penalty of forty shillings on the emission of an exorbitant amount of black smoke. But even perfect combustion of coal would remove but a very small part of the evil resulting from its use. What is needed is to restrict the consumption of coal to the lowest practicable amount. Some manufacturers use three times as much coal to obtain a given amount of steam-power as do others in the same district. Here the law should interfere, and ascertaining what is the minimum amount of fuel consumed per horse-power produced, impose penalties on all excess of this standard. Thus we might hope to see a reduction in the amount of sulphurous acid which now withers up our fields, corrodes our public edifices, and irritates our lungs.

We shall watch the progress of this Bill with interest, but we fear that no probable amendments will convert it into a sound and creditable measure.

THE DECOMPOSITION OF WATER BY ZINC IN CONJUNCTION WITH A MORE NEGATIVE METAL.[*]

By J. H. GLADSTONE, Ph.D., F.R.S.,
and ALFRED TRIBE, F.C.S.

Pure zinc is incapable of decomposing pure water, even at 100° C., but at a considerably higher temperature it is known to combine with its oxygen. Davy exposed pure water for two days to the action of a pile of silver and zinc plates, separated only by pasteboard, without obtaining any hydrogen; Buff, however, had shown that a very minute trace of gas can be formed at the ordinary temperature by a pair of zinc and platinum plates.

During a series of experiments, of which we have already published an instalment, it occurred to us to ascertain whether by bringing the two metals closer together, and so increasing the electrical tension of the liquid, we could effect the same combination of zinc with oxygen, at the ordinary temperature, which takes place without the second metal at a very high temperature. Thin sheets of zinc and copper were hammered together and placed in a bottle filled with distilled water. Small bubbles of gas were formed. The experiment, however, was tried in a more perfect form. Some zinc-foil was allowed to remain in a somewhat dilute solution of copper sulphate until its surface was well covered with spongy copper. The metals were thoroughly washed with distilled water, and then they were immersed in a bottle of distilled water with a delivery-tube. Minute bubbles of gas quickly made their appearance, which proved to be hydrogen, and zinc-oxide was formed. Two experiments were made quantitatively, the gas being collected and measured at the end of twenty-four or forty-eight hours. The quantity of gas in cubic centimetres is given in the third and fourth columns of the subjoined Table, corrected for temperature and pressure. The mean temperature in

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[*] Read before the Royal Society.

the second column is simply the mean of the maximum and minimum during the period. In experiment A, 33·4 grms. of zinc-foil were employed, being 2·6 metres long, and 0·05 wide. The coils were kept apart by muslin. In experiment B there was used 1 metre of similar foil crumpled up.

Day.	Mean Temp. ° C.	Expt. A. c.c.	Expt. B. c.c.
1.	12·8	117·1	49·6
2.	12·2	93·8	37·5
3.	11·7	73·8	27·6
4.	11·1	66·2	24·7
5, 6.	10·0	49·3 (×2)	17·5 (×2)
7.	8·9	41·1	14·9
8.	10·5	40·9	15·8
9.	10·0	40·9	14·8
10.	7·8	33·8	10·3
11.	6·7	28·0	9·4
12, 13.	6·1	21·9 (×2)	7·7 (×2)
14.	6·1	20·1	7·6
15.	7·2	31·1	10·3
16.	10·0	30·0	10·2
17.	8·3	29·4	8·5
18.	6·7	20·0	7·6
19, 20.	6·1	17·2 (×2)	5·7 (×2)
21.	4·4	20·0	6·6
22.	5·0	15·3	4·8
Interval.			
44.	10·0	20·5	5·5
45, 46.	10·5	22·5 (×2)	6·5 (×2)
47.	11·1	22·3	6·5
48.	11·1	24·1	8·1
49.	11·1	20·5	7·4
Interval.			
82.	10·0	18·0	4·7
83.	10·0	18·9	6·1
84.	10·0	14·0	5·1

The two experiments have evidently gone on almost *pari passu* for months, the amount of hydrogen evolved gradually diminishing, but showing, at the same time, a certain dependence on the heat of the day.

Under the microscope the bubbles of gas are seen to form, not on the zinc, but among the copper crystals, and sometimes to make their appearance on the glass at some distance off.

From the position of platinum in the electro-chemical series, we anticipated that the effect would be still more marked with that metal in a spongy state on the zinc. It was deposited from the tetrachloride, and, of course, thoroughly washed. There was only 0·6 metre of foil, but the following quantities of hydrogen were obtained:—

Day.	Mean Temp. ° C.	Vol. in c.c.
1.	11·7	143·6
2.	11·4	93·6
3, 4.	10·0	38·8 (×2)
5.	8·6	26·0
6.	10·8	21·0
7.	9·4	17·1
8.	7·7	12·3

The first action, therefore, was about five times as great as in the case of the copper, and it diminished more rapidly; doubtless through the zinc becoming more quickly protected by oxide.

Lest it might be contended that the free oxygen usually present in distilled water had been the means of starting this action, the experiment was repeated with water as free from oxygen as could be obtained by boiling. One metre of the same zinc-foil, covered with copper, was employed, and the result was nearly as before, 40 c.c. of gas being obtained the first day at the mean temperature of 9° C. This arrangement was taken advantage of to examine the effect of a high temperature. Without removing the delivery-tube, the contents of the flask were heated to near 100° C., when 123·5 c.c. of hydrogen were given off in ten minutes. The apparatus was allowed to cool, with the mouth of the tube under water, when the production of gas became small again, and, after two days it was again heated nearly to the boiling-point, when it gave off 93·4 c.c. in ten minutes; after another period of two days it gave 64·1 c.c.; and after three days more 132·1 c.c. in the first thirty minutes, 108·4 in the second thirty minutes, 94·3 in the third, and 89·9 in the fourth.

Iron and lead, under similar circumstances, also decomposed pure water, and the action of magnesium was greatly increased by conjunction with copper. The effect of the more negative metal was the same as would have been produced by an increase of heat.

In a practical point of view this experiment may serve as a ready means of preparing pure hydrogen; in a theoretical point of view, its interest seems to lie in the fact that the dissociation of a binary compound by means of two metals may take place at infinitesimally short distances, when it would not take place were the layer of liquid enough to offer resistance to the current, and also in the correlation between this force and heat.*

ON COMETARY PHENOMENA.

By Professor W. A. NORTON.

In the *College Courant* of the 17th inst., under the head of the "Phenomena of Comets," quotations were made from a recent communication to the Chemical News by Professor Osborne Reynolds, containing allusions to certain investigations of mine on Donati's comet. The author represents me as having reached the result that the repulsive force exerted by the sun on cometic matter, urging it away from the head of the comet to form the luminous train, is "equal to from 0·75 to 0·55, the attraction of the sun for ordinary matter." This is an erroneous statement, and gives no adequate idea of the results actually obtained in the discussion referred to. My investigations on Donati's comet were undertaken with the view of subjecting the hypothesis of a solar repulsion of cometic matter, first propounded by Olbers, and ably maintained by Bessel, to a rigorous numerical test, by comparing quantitative theoretical determinations with the results of astronomical observation and measurement. For this purpose a long series of elaborate calculations were entered into, and detailed comparisons made with the actual comet as astronomically observed and measured. The following points were established by the discussion:—

(1). The preceding half of the tail of the comet was composed of matter repelled from the sun with a force varying in intensity with the different particles between the limits 0 and 1·5 (the force of gravitation being taken as the unit; the 0 line of particles differing but little from the middle line of the length of the tail, and the 1·5 line being its convex outline.

(2). The following half of the train was made up of matter subject to a diminished solar attraction varying between the limits 0 and 0·6; the latter obtaining along the concave outline.

These were the results upon the assumption that the particles left the head of the comet without lateral velocity. It was found that small initial lateral velocities might be assumed, and a train of nearly the same position, form, and dimensions, theoretically calculated, provided the above limits for the two sides of the tail were reduced from 1·5 and 0·6 to 1·213 and 0·455.

(3). It followed from the above results that the solar repulsion operated upon certain different portions of the matter expelled, with unequal intensities, in some instances exceeding the force of gravitation, and in others being of a less intensity; and that while the effective force

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* Since the above was written we have accidentally heard that Dr. W. Russell has been working in the same direction.

in operation varied between the limits just given, the actual repulsion varied between the limits 0·4 and 2·5; or if initial lateral velocities obtained, between 0·55 and 2·21.

(4). All the unequally repelled particles that set out at the same instant were found, at the end of any assumed interval of time, situated upon a right line traversing the tail obliquely, and which, if prolonged backwards, would pass nearly through the head of the comet. It followed from this that the matter expelled on several successive days would be found, at the end of that number of days, disposed in divergent bands lying in directions radiating out from the head of the comet, or nearly so. These bands should, however, form one continuous luminous mass, if the previous emission of the cometic matter had been the same from day to day, or had varied steadily and by slow degrees. This was, in fact, the ordinary appearance presented by the tail of the comet, but on certain evenings it was seen by Professor Bond and other observers, to have, at a distance from the nucleus, a "columnar structure," or to be arranged in an "alternation of bright streaks with intermediate darkness." These streaks, which were about ½° in breadth, conformed in their direction to the bands of particles previously emitted at successive intervals of a day, or thereabouts. We may infer, therefore, that the evolution from the head of the comet, of the matter that was urged away by the solar repulsion to form the train, was for a time periodically intermittent.

Professor Reynolds intimates that I did not suggest any explanation of the straight secondary tails, or streamers. This is a mistake. In a brief abstract of the principal memoir, published at an earlier date, it was stated to be one result of the discussion that these "were but lines of receding particles subject to much greater forces of repulsion than the other particles ejected from the nucleus." Two nearly straight narrow streamers were seen, on certain evenings, extending out from the convex side of the tail. They had the directions of lines of simultaneously ejected particles, and probably consisted of some more subtile nebulous matter, for which the varying repulsive action of the sun ran up to a very much higher limit than 1·5.

The sun is undoubtedly the great agent in the production of cometary phenomena; and he must act in two ways, for portions of the cometic matter are first brought by some solar agency into the condition to be repelled, which must then be repelled to great distances by the same or some other solar agency. Since the sun's force of repulsion varies in the inverse ratio of the square of the distance, and all the known forces received from the sun are propagated by ethereal waves, we infer that this repulsion is, in all probability, some form of wave-force emanating from the sun. If so, unless we have recourse to hypothetical agencies, we must conclude that the force in question is either a heat-repulsion or an electric repulsion. Our author's hypothesis, that it is of electric origin, is not a new one. It is open to the serious objection that electricity cannot experimentally be made to traverse a vacuum. It is true that this experimental result may be due to electrical conditions which do not exist at the surface of the sun's photosphere; and it is also true that the hypothesis that the electric ether pervades all space, furnishes a direct solution of the mysterious electric and magnetic sympathy existing between the sun and the earth, and thus has a certain air of probability. The necessity of this hypothesis cannot, however, be admitted, since the sympathetic communication between these cosmical bodies may subsist through the intervention of the luminiferous ether. If this electrical hypothesis should be conceded, the conditions through which heat may be conceived to evolve the cometary phenomena would also subsist with regard to electricity, and it would be difficult to decide between these two agencies. The electric theory of the phenomena of comets, and of certain apparently cognate terrestrial and solar phenomena, I have discussed in different communications to the *American Journal of Science*, without, however, finally adopting it. While deeming it probable that electricity may play a certain part in the diverse processes of transformation through which the head of a comet passes, under the varying influence of the sun, I have taken the ground, in my later papers, that the solar heat is the principal agent in the production of cometary phenomena. The sun's heat may determine that condition of the cometic matter in which it becomes subject to a repulsive action from the sun, either by dissociating the molecules or atoms, and so diminishing their power of absorbing heat, or by producing this effect directly without dissociation. For it is to be observed, that it is only that portion of the solar heat which is not absorbed by the molecules, or atoms, that can be effective in any degree as an impulsive force. The inequality of the sun's repulsion for different portions of matter expelled may be ascribed to inequalities in the size of the atoms of different vapours exposed to the wave force—the smaller atoms taking the higher velocities—or to unequal absorptive powers for heat of different atoms or molecules.

The theory of an universal force of repulsion (due to insensible and sensible heat), operating at all distances beyond the recognised limit of the attraction of cohesion of the molecules of ordinary bodies of matter, I have urged in different papers published in the *American Journal of Science*—maintaining that it is the determining cause of the conditions and phenomena of the contact of bodies, whether by statical pressure or by impact (in which in general no evidence is perceived of a sphere of attractive action being passed through before the repulsion comes into operation); that it constitutes the elastic pressure of gases; that as a force of cosmical repulsion taking effect upon highly attenuated vapours, with small atomic weights, it is the great agent in the wonderful processes of change through which cometary bodies are seen to pass, and at the sun's surface in urging upward, with a high velocity and to great heights, the incandescent masses of hydrogen that are seen as "red protuberances" on the edge of the solar disk in total eclipses, and in expelling to much greater distances the still more subtile vapour recognised by spectroscopists as forming the substance of the solar corona.

Sheffield Scientific School, New Haven., Conn.,
February 27, 1872.

NOTES IN SUPPORT OF THE ALLEGED ALKALINITY OF CARBONATE OF LIME.*

By WILLIAM SKEY,
Government Analyst, New Zealand.

In a paper of mine which appeared in the second volume of the *Transactions of the Wellington Philosophical Society*, I asserted the alkalinity of carbonate of lime, but the correctness of this assertion having been disputed by Mr. Charles R. C. Tichborne, F.C.S., M.R.I.A., &c., of the Laboratory of the Apothecaries Hall, Ireland, in a communication to the editor of the Chemical News (vol. xxii., p. 150), I have re-investigated this subject, and extended my researches upon it, by which I have arrived at results corroborative of the correctness of my statement, and which show, besides, that a large number of salts hitherto maintained to be neutral, or respecting which nothing has been affirmed, are in reality alkaline.

The latter results I will communicate here at any early date in a separate form, limiting this paper to an attempt to clear the ground already broken as far as I am able from the objections above referred to.

Mr. Tichborne very courteously, and with a considerable amount of plausibility, argues that "as the reddened

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* Read before the Wellington Philosophical Society, September 30th, 1871.

litmus which I used has the acid used to colour it only weakly combined with the tinctorial matter of the paper, the carbonate of calcium merely acts by abstracting this acid, and thus the litmus is brought back to its normal colour, blue with a shade of violet, and therefore this is not a reliable test in such a case."

In answer to this I would ask, Does not the capacity of the lime-salt to abstract the acid, whether acetic or carbonic (for I guarded against encumbering the process with a double decomposition by using the latter acid), argue most forcibly and sufficiently for its alkalinity?

If it does not demonstrate alkalinity in such a case, then reddened litmus, in opposition to all received opinion on this head, is not a proper, nor, indeed, a test at all, for ascertaining this character for *any* substance. I would ask, what other condition or property is required for a substance besides that enabling it to act as an alkali upon litmus, wanting which it is neutral?

However, I will not press this point further, as I do not wish to rely upon one set of experiments or upon any particular method I have adopted in them for testing the truth of my allegation. I have therefore availed myself of the use of the first test suggested by Mr. Tichborne for determining the question finally, and the results of this I will now describe.

Blue litmus paper, after being well washed in distilled water free from ammonia till of a pale violet colour, had its colour very distinctly changed to a deep blue on being pressed while moist upon a freshly fractured surface of calcspar. The failure of Mr. Tichborne to obtain a like result under the conditions he named I can only explain upon the supposition that a sufficient area of contact was not ensured between the spar and the paper to make the result a visible one.

In regard to Mr. Tichborne's second test, I take exception to the employment of *turmeric* paper in such a case as this, as it only shows alkalinity where it exists to a marked extent, and this is not a question of *degree*, but one of *condition*—alkalinity or neutrality.

That turmeric paper cannot indicate alkalinity where this does not reach to a certain intensity is manifest from the refusal of the organic base, aniline, to affect it, though it acts both upon the juice of red cabbage and reddened litmus as a body having alkaline characters, which character we uniformly accord it.

Again, pure strychnia I find, though not able to affect turmeric, behaves with reddened litmus like an alkaline body, which it certainly is; and this, by the way, may be the character or behaviour of the alkaloids generally with such tests.

Lastly, to anticipate a little of what I am leaving over, hydrous tribasic phosphate of lime does not colour turmeric, although, we are sure, from the manner in which it may be produced, and the circumstances attending its formation, that it must be alkaline—which character it plainly manifests to reddened litmus.

Thus, we can mix alkaline solutions of chloride of calcium and tribasic phosphate of soda, and the precipitate of phosphate of lime which falls leaves the supernatant solution distinctly *acid*. Now as we have no reason for supposing that the phosphoric acid in changing bases has lost any portion of its combining or neutralising power, we are constrained to hold that the precipitate thus resulting is (as this litmus demonstrates) alkaline—alkaline at least to an extent equally divergent from neutrality, as is the acid solution around it—and still turmeric gives no sign.

The turmeric paper test being, therefore, obviously unreliable for the detection of alkalinity in many cases, I rely for the verification of the correctness of the statement in question upon the results of the first test suggested in this criticism.

I have to apologise for having allowed such a length of time to elapse ere noticing these objections of Mr. Tichborne, but I waited thus in the hope that some one else might have taken up the question with such authority and potency of argument that would have sufficed to settle it one way or the other, and thus saved me further thought upon it, as it is so much more pleasant and exhilarating—besides being more in accordance with our colonial instincts—to break up fresh ground or explore new country than to turn back from this to tinkering about old work or to protect it from hostile blasts, even though these be ever so courteously blown or kindly tempered.

I will only add, I shall be very pleased to have this subject still further discussed, especially as it now appears likely that some general principle may soon be recognised, by the use of which we can easily and certainly classify into the three distinctive groups—acidic, basic, and neutral—those bodies whose reaction with test-paper is difficult to observe by reason of their intense colour or their extreme insolubility in water.

THE SPECIFIC GRAVITY OF OILS AND THEIR CO-EFFICIENT OF EXPANSION.

By C. M. STILLWELL, A.M.

The sp. gr. of oils as determined by oleometers is liable to inaccuracy from imperfect instruments. I am accustomed, in testing oils, to reject the use of the oleometer, and to determine the sp. gr. by finding the weight of a known volume of the oil, and calculating its sp. gr. with reference to water at 15° C. The sp. gr. varies very much with increase of temperature. In order to reduce the found sp. gr. to the sp. gr. at 15° C., it is necessary to know the co-efficient of expansion of oil.

For the determination I use a 50 c.c. flask.

It is necessary, first, to very carefully determine the weight of boiled distilled water which the flask contains at 15° C. This having been determined, we next find the weight of 50 c.c. of the oil under examination, and the temperature at which this is taken. Then, the weight of oil, divided by the weight of water at 15° C., will give the sp. gr. of the oil at the observed temperature.

For example: 50 c.c. of castor-oil at 17·2° C., equalled 47·6487 grms. This, divided by the weight of 50 c.c. of water at 15° C., equalled 0·9654, that is, 0·9654 is the sp. gr. of the sample at 17·2° C.

The co-efficient of expansion is the difference in sp. gr. which corresponds to a difference in temperature of 1° C.

Suppose the sp. gr. of an oil is determined at 15° C., and is found to be 0·9162. The sp. gr. of the same oil determined at 20° C. is 0·9131. The difference, 0·0031, corresponds to an increase of 5° C.; that is, 0·00062 for 1° C. In the same way the co-efficient of expansion is determined with sp. gr. taken at different temperatures and the average taken. I have made such determinations, and the following are the average results of a large number of trials:—

Temp.	Co-ef. of Exp.
14·4° C. to 20° C.	= 0·000642
14·4° ,, 25°	= 0·000641
15·0° ,, 20°	= 0·000610
15·0° ,, 25°	= 0·000625
Average	0·000629

or the co-efficient of expansion is 0·00063 for 1° C.

The oil selected for this determination was pure virgin olive oil.

In testing an oil by this method, it is best to make the determinations at a temperature as near 15° C. as possible.

We have then this rule: multiply the difference between 15° C., and x° C. by 0·00063, and add or subtract the product to or from the sp. gr. previously obtained, according as the temperature is above or below 15° C.

In the example above quoted, the sp. gr. of castor-oil is found to be 0·9654 at 17·2° C. To refer this to 15° C.

we have: $17{\cdot}2^\circ - 15^\circ = 2{\cdot}2 \times 0{\cdot}00063 = 0{\cdot}001386 \therefore 0{\cdot}9654 + 0{\cdot}0013 = 0{\cdot}9667 =$ the sp. gr. at 15° C.

To clean flasks, test-tubes, &c., which have contained oil, I use the following method:—Let the oil drain off well; then put into the flask a little saponified red oil, or better, melt a little palm oil therein, and unite it with the oil by turning the flask around. The resulting mixture is very easily saponified by a hot caustic alkali. Every trace of oil can be removed by this treatment, which is far less expensive and troublesome than treatment with ether.

Commercial oils differ very much in sp. gr., although they may be classed under the same name. In the following table I give the results of my tests of the chief commercial oils. With but few exceptions, I procured the samples from first hands, and I believe them to be fair average samples of the oils sold.

Table of Specific Gravity of Oils.

Co-eff. of exp = 0·00063 for 1° C.

	15° C. 59° F.
Sperm, bleached, winter	0·8813
,, natural, winter	0·8815
Elaine	0·9011
Red, saponified	0·9016
Palm	0·9046
Tallow	0·9137
Neats-foot	0·9142
Rape-seed, white, winter	0·9144
Olive, light greenish yellow	0·9144
Olive, dark green	0·9145
Pea-nut	0·9154
Olive, virgin, very light yellow	0·9163
Rape-seed, dark yellow	0·9168
Olive, virgin, dark clear yellow	0·9169
Lard, winter	0·9175
Sea-elephant	0·9199
Tanners' (cod)	0·9205
Cotton-seed, raw	0·9224
Cotton-seed, refined, yellow	0·9230
Salad (cotton-seed)	0·9231
Labrador (cod)	0·9237
Poppy	0·9245
Seal, natural	0·9246
Cocoa-nut	0·9250
Whale, natural, winter	0·9254
Whale, bleached, winter	0·9258
Cod-liver, pure	0·9270
Seal, racked	0·9286
Cotton-seed, white, winter	0·9288
Straits (cod)	0·9290
Menhaden, dark	0·9292
Linseed, raw	0·9299
Bank (cod)	0·9320
Menhaden, light	0·9325
Porgy	0·9332
Linseed, boiled	0·9411
Castor, pure cold-pressed	0·9667
Rosin, third run	0·9887

—*American Chemist.*

ON SOME EXPERIMENTS WITH FEHLING'S COPPER SOLUTION.[*]

By T. L. PATTERSON, F.C.S.

The copper solutions used in the following experiments were prepared according to the instructions given by Fresenius. 34·632 grms. of sulphate of copper, dissolved in 200 c.c. of water, were added to a solution of 173 grms. of tartrate of soda and potash in 480 c.c. of soda solution of 1·14 sp. gr. or thereby, and the whole made up to 1 litre. They were tested with one of inverted sugar, prepared as follows:—0·5 grm. of pure dry loaf sugar free from glucose was dissolved in a small flask in 10 c.c. of water, 30 drops of HCl added, and a thermometer inserted. The flask, with its contents, was then placed in a water-bath for fifteen minutes, or until the thermometer indicated 70° C., when it was removed and diluted to 300 c.c. Each c.c. of this solution was thus equal to 0·001754 grm. of glucose.

The experiments were conducted in flasks, rather than basins or beakers; because, with the latter that portion above the liquid is liable to become over-heated to such an extent that, when the solution is stirred or shaken, part of it is likely to become reduced, and thus lead to erroneous results. Flasks are not liable to the same objection if they be occasionally shaken until they boil. When any portion is thus reduced the whole must be rejected.

Experiment 1.—(*a*). 10 c.c. of a copper solution were boiled with about 40 c.c. of water in a flask without precipitation. The standard sugar solution was then added from a burette graduated to $\frac{1}{5}$th c.c. until, on filtering off a portion rapidly, no copper-coloured precipitate was obtained on the addition of a few drops of acetic acid and one drop of a very dilute solution of ferrocyanide of potassium. 30 c.c. were thus consumed. Another experiment gave the same result, and $30 \times 0{\cdot}001754 = 0{\cdot}05262$ grm. of glucose, the amount required to reduce 10 c.c. of copper solution.

(*b*). 10 c.c. of the same solution were treated precisely as in (*a*), with the addition of 10 c.c. of soda solution of sp. gr. 1·163. It now required 33 c.c. of the sugar solution for complete reduction, which is equal to 0·05788 grm. of glucose.

(*c*). Other 10 c.c. were boiled with the addition of 50 c.c. of soda solution. When 34 c.c. of sugar solution had been consumed the cupric oxide was not all reduced; nor was reduction complete after the further addition of 14 c.c. in quantities of 2 c.c. at a time, testing after each addition. The result was the same when 50 c.c. were added to another portion of 10 c.c. in quantities of 5 c.c. after the 35th c.c.

The results of this experiment lead me to question the conclusions of Fehling, Fresenius, and others, who assume that 1 molecule of grape sugar reduces 10 molecules of cupric oxide. Had this been the case, 10 c.c. of the solution in (*a*) would have consumed 28·5 c.c. of the standard sugar solution, equal to 0·05 grm. of glucose, whereas 30 c.c. = 0·05262 grm. were required. (*b*) and (*c*) I believe show the reason of this, and prove satisfactorily that the quantity of cupric oxide reduced depends as well upon the alkalinity of the solution as on the amount of oxide of copper which it contains. Consequently, as the amount of soda varies, the solution's power of oxidising grape sugar will also vary, and must be determined for each solution separately. When, moreover, the soda is in great excess, as in (*c*), accurate results cannot be obtained.

Experiment 2.—With the view of showing the effect of soda on an old solution, the following experiments were made:—

(*d*). A copper solution, 10 c.c. of which were equal to 0·05262 grm. grape sugar, had been in occasional use for about five months. For some time soda had to be added to prevent precipitation. 10 c.c. were found to equal 0·039 grm. of glucose; but, with the addition of 40 c.c. or so of soda, 10 c.c. were equal to 0·05614 grm. of glucose.

(*e*). Another solution, having the same sugar-destroying power as (*d*), at the end of five months precipitated on boiling. 10 c.c. were equal to 0·04035 grm. of grape sugar. 10 c.c. + 10 c.c. of soda solution of 1·13 sp. gr., and 30 c.c. or so of water, did not precipitate on boiling, and consumed sugar solution equal to 0·05331 grm. of glucose; and 10 c.c. + an addition of 50 c.c. of soda solution required 0·05702 grm. of inverted sugar for complete reduction.

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[*] Read before the Glasgow Philosophical Society, March 11, 1872.

We learn from this experiment that soda renews an old solution, as is well known ; but the alkali must be added sparingly—in fact, not more than is necessary to prevent precipitation on boiling, otherwise it will have too high a glucose-destroying power, and so give a low percentage of fruit sugar in any sample of sugar under examination. We see here also, as in Experiment 1, that the oxidising power of the cupric solution increases as the quantity of alkali increases ; and so, by the addition of soda in excess, an old solution can be made to represent a greater amount of glucose than the same solution did when new !

The deterioration of copper solutions kept for some time, such as those in Experiment 2, has been variously attributed to the action of light, absorption of carbonic acid, &c. In Watts's "Dictionary," we are told to preserve the solution in well-closed vessels to protect it from CO_2 and air. But, even when so protected and kept in the dark, a solution in constant use still deteriorates. To what, then, is this deterioration due ? I have always found, on removing the stopper from a cupric solution bottle which has not been opened for a few days, that a partial vacuum existed within, and the vacuum was the greater the longer the bottle remained closed. Clearly this vacuum is not due to the absorption of the small amount of CO_2 in the air of the bottle ; it must, therefore, be owing to the absorption of oxygen : and this I find to be the case, for, on inserting a lighted splinter into a bottle half-filled with the solution, it is at once extinguished, nor can it be made to enter beyond the neck—a sufficient proof that the gas in the bottle is nitrogen.

Experiment 3.—To determine the amount of this absorption, whether it was partial or complete, the following experiment was made :—Into a tube closed at one end, containing 50 c.c., and graduated into $\frac{1}{5}$th c.c., I enclosed a quantity of dry air over mercury, which, after reduction to 0° C. and 760 m.m. pressure, measured 42·76 c.c. 4 c.c. of copper solution—10 c.c. of which equal 0·05175 grm. of glucose—were then introduced, and the whole set aside in diffuse daylight. The experiment lasted about 8 months. Absorption was slow and gradual, extending over a considerable period, but not so long as this experiment would lead one to believe. It was only allowed to stand so long, in order to be quite certain that absorption had ceased.

The copper solution in the tube had now a much lighter colour, and cupreous oxide was deposited on the sides for the space of about a c.c. where the mercury first came in contact with the solution. The reading of the tube, after making all the necessary corrections, was 34·09 c.c. at 0° C., and 760 m.m. barometer. Now, $42·76 - 34·09 = 8·67$ c.c. oxygen absorbed by the 4 c.c. of copper solution, and $\frac{8·67}{42·76} \times 100 = 20·28$ per cent of the original air. This agrees very well with the quantity of oxygen in the air, as determined by Bunsen, viz., 20·93 per cent, and shows that all the oxygen has been absorbed. The difference is due to experimental error ; for instance, the barometer used was an aneroid, which always showed a slight variation when compared with a standard. The residual nitrogen was tested as before, but it would not support combustion.

The foregoing experiment shows satisfactorily the complete absorption of oxygen by the liquid ; and in order to observe further the effect of oxidation and decomposition another experiment was made.

Experiment 4.—(*f*). The copper solution used in this experiment had a glucose-destroying power of 0·04965 grm. per 10 c.c. The CO_2 and Na_2O were estimated in separate portions of 10 c.c. each—the former in a CO_2 apparatus, and the latter by saturation with normal solution of H_2SO_4, boiling to expel CO_2, and backward titration with normal Na_2O solution. The Cu solution was thus found to contain 0·18 grm. of CO_2, and to have a neutralising power of 5·39 grm. Na_2O per 100 c.c.

Having been in almost daily use for a month, during which time it was kept in a cupboard, the solution was nearly finished Ther was still no precipitation on boiling. 100 c.c. contained 0·30 grm. of CO_2, and had a neutralising power of 5·26 grms. Na_2O.

Two small bottles, (*g*) and (*h*), were half filled with solution (*f*), and securely stoppered. (*h*) was placed in the direct sun's rays, and (*g*) was rolled in paper and placed in a tin case, in order thoroughly to exclude light. After the lapse of eight months the bottles were opened and analysed.

(*g*). That bottle kept in the dark had not changed in depth of colour, no precipitate had formed, it remained perfectly clear on boiling, and contained 0·18 grm. of CO_2, with a neutralising power of 5·27 grm. of Na_2O per 100 c.c.

(*h*). The second bottle, exposed in the direct solar rays, was much lighter in colour, the stopper was with difficulty removed, and there was deposited at the bottom a copious crystalline precipitate of cupreous oxide. The solution filtered from this precipitate gave a second precipitate on boiling, and 10 c.c. were equal to 0·00087 grm. of glucose. It contained 0·33 grm. of CO_2, and had a neutralising power of 4·89 grms. of Na_2O per 100 c.c.

The injurious effect of light on this solution is very well seen in (*h*). Nearly all the Cu has been precipitated ; while the solutions, (*f*) at the end of one month, and (*g*), are quite unaffected by boiling. (*h*) has also increased 0·15 grm. of CO_2, and decreased 0·5 grm. of Na_2O, in neutralising power per 100 c.c. Now this gain in CO_2 could not have been the result of absorption from the atmosphere, for the CO_2 had not increased in the bottle kept in the dark (*g*), and the partial vacuum in the bottle showed that the stopper was perfectly tight. Nor could it have been produced by oxidation, as the bottle in which the solution was contained held about 100 c.c., and was half-filled with the solution, the other half being air. 50 c.c. of air, weighing 0·0608 grm., and containing 0·014 grm. of O, are only equal to 0·01924 grm. of CO_2, whereas 0·075 grm., nearly four times that quantity, was found. Therefore the CO_2 found in this experiment is partially produced by oxidation, and partially the result of the decomposition of the tartaric acid promoted by the actinic rays.

The fixation of 0·50 grm. of Na_2O is conclusive on this point. The tartaric acid, under the influence of light and absorbed O, becomes split up in such a manner that its neutralising power is considerably increased in presence of the free alkali. We may suppose one molecule of the bibasic acid to decompose into one of another bibasic and one of a monobasic acid, besides CO_2, and so exert an extra-neutralising power on the Na_2O to that extent. I made no experiments to determine what acids these are, but they are likely to be related to oxalic, and contain less carbon than tartaric acid.

At the end of one month (*f*) had gained 0·12 grm. of CO_2, and lost in alkalinity 0·13 grm. of Na_2O. This decomposition is similar to that of (*h*), but, for want of time and exposure to light, has not proceeded to the same extent. From the fact, however, of this bottle being in constant use—not under precise conditions, but kept principally in the dark, though occasionally in the light—now open, and again closed—I will not hazard an opinion on the results.

The CO_2 in (*g*), the bottle kept in the dark, was the same at the end as at the commencement of the experiment ; but the alkalinity of the solution had decreased to the extent of 0·12 grm. of Na_2O per 100 c.c. So that, although when kept in the dark in well-stoppered bottles the solution does not oxidise, yet it undergoes a slight internal decomposition, similar to that induced by light in (*h*), whereby the fixed acidity is increased in presence of the excess of alkali. Light is thus necessary for oxidation, and darkness retards decomposition ; phenomena which I venture to assert are more general than at first sight might be supposed. With the exception of the decrease in alkali, the (*g*) solution may be said to be as good and sound as the original solution (*f*), proving that it can be preserved, under exceptional conditions, for a reasonable length of time (eight months in this case).

In Experiment 2, (*d*) and (*e*), I have shown the deteriorating influence of age on solutions in constant use. For the purpose of these experiments my solutions have been kept in the dark; but I have been in the habit of using bottles for preserving the solution, made by the York Glass Company from a kind of dark green glass. These bottles cut off the actinic end of the spectrum as far as the green, and are useful for preserving HNO_3, silver and other salts, decomposed by light. To test the preservative qualities of this glass for the Cu solution, I made another experiment, as follows:—

Experiment 5.—One of the green bottles was half-filled with the solution and placed in the direct rays of the sun for six months. At the commencement of the experiment 10 c.c. were equal to 0·05179 grm. of grape sugar; at the end, 10 c.c. were equal to 0·05000 grm., and the solution when boiled showed no sign of precipitation. The result is thus in favour of these bottles; for with this severe test the solution has only lost the power of oxidising 0·00179 grm. of glucose, while that kept in a white glass bottle under the same circumstances (*h*) had nearly all its Cu precipitated.

Did Fehling's solution only deteriorate by the absorption of O, there might be inserted in the bottle a perforated cork, through which a tube passed holding fragments of pumice moistened with a strong solution of pyrogallate of potash. I have not tried this arrangement; but, as I have shown, in Experiment 4 (*g*) and (*h*), that decomposition takes place without the absorption of O, I do not think any useful purpose would be served by such an addition.

In conclusion, these experiments show—

(1). That Fehling's solution has no definite grape sugar equivalent depending upon the weight of cupric oxide it contains, but that its glucose-destroying power varies directly (within certain limits) with the quantity of alkali present; and that when Na_2O is in great excess all the Cu cannot be precipitated with a solution of inverted sugar.—Experiment 1, (*a*) (*b*) (*c*).

(2). That old solutions are renewed by an addition of Na_2O, as our text-books set forth; and, moreover, that by adding the alkali in considerable excess, the glucose-destroying power of the solution can be made to exceed that of the same solution when first prepared.—Experiment 2, (*d*) (*e*).

(3). That all the oxygen is absorbed by the solution from air in a confined space, as in a partially filled bottle. —Experiment 3.

(4). That, under the influence of light, decomposition is almost complete; and CO_2 increases to a greater extent than can be accounted for by the absorption of oxygen.—Experiment 4, (*h*).

(5). That the amount of Na_2O in the solution decreases with its age, even when kept in total darkness; and that this loss of alkalinity is to be attributed to the decomposition of the organic acid into other fixed acids, the total acidity of which is greater than that of the original tartaric acid.—Experiment 4, (*f*) (*g*) (*h*).

(6). That a solution kept for eight months away from light in a bottle containing air is in good condition at the end of that time.—Experiment 4, (*g*).

(7). That the solution is best kept for use in dark green bottles which exclude the actinic rays.—Experiment 5.

The President, after referring to the great scientific and practical interest of Mr. Patterson's paper, said that he had himself found the same results in his operations, although he had not prosecuted his inquiries as to the cause of those results to the same extent as the author of this paper. One thing he had observed was, the solution should be frequently renewed.

Mr. Sutherland referred to the action of carbonate of soda, and asked Mr. Patterson if he had tried it. He had found it useful in determining the amount of glucose in glycerine, and would like to know if there was any true glucose in ordinary sugar.

Mr. Patterson observed that he had not tried carbonate of soda in sugar testing, and that it was inverted sugar rather than true glucose that had to be determined. In reply to Mr. Tatlock, he observed that it was probable that the red precipitate found in the operations was due to the decomposition of tartaric acid.

ON THE
RELATIVE POWER OF VARIOUS SUBSTANCES IN PREVENTING PUTREFACTION
AND THE
DEVELOPMENT OF PROTOPLASMIC AND FUNGUS LIFE.[*]

By Dr. F. CRACE CALVERT, F.R.S.

To carry out this series of experiments, small test-tubes were thoroughly cleansed and heated to dull redness. Into each was placed 26 grms. of a solution of albumen containing 1 part of white of egg to 4 parts of pure distilled water, prepared as described in my paper on protoplasmic life. To this was added 1-1000th, or 0·026 grms., of each of the substances the action of which I desired to study.

The reasons why I employed 1 part in 1000 are twofold. First, the employment of larger proportions would, in some instances, have coagulated the albumen; secondly, it would have increased the difficulty of observing the relative powers of the most efficacious antiseptics in preventing the development of the germs of putrefaction or decay.

A drop was taken from each of the tubes, and examined under a microscope having a magnifying power of 800 diameters. This operation was repeated daily with the contents of each tube for thirty-nine days, and from time to time for eighty days. During this time, the tubes were kept in a room the temperature of which did not vary more than 3°, viz., from 12·5° C. to 15·5° C.

In order the better to show the influence of the antiseptics used, I examined two specimens of the same solution at the same time, one of which was kept in the laboratory, the other in the open air.

A marked difference was observed in the result; the one kept outside becoming impregnated with animal life in less than half the time required by the other, while as many vibrios were developed in six days in the tube kept outside as were developed in thirty days in the tube in the laboratory.

A summary of the results of the experiments is given in the following table, in which the substances are grouped according to their chemical nature:—

	Days required for Development of—	
	Fungi.	Vibrios.
1. *Standard Solutions.*		
Albumen kept in laboratory for comparison	18	12
Albumen exposed outside laboratory	None	5
2. *Acids.*		
Sulphurous acid	21	11
Sulphuric acid	9	9
Nitric acid	10	10
Arsenious acid..	18	22
Acetic acid	9	30
Prussic acid	None	9
3. *Alkalies.*		
Caustic soda	18	24
Caustic potash..	16	26
Caustic ammonia	20	24
Caustic lime	None	13

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[*] Abstract of a Paper read before the Royal Society.

	Days required for Development of— Fungi.	Days required for Development of— Vibrios.
4. *Chlorine Compounds.*		
Solution of chlorine	22	7
Chloride of sodium	19	14
Chloride of calcium	18	7
Chloride of aluminium	21	10
Chloride of zinc	53	None
Bichloride of mercury	81	None
Chloride of lime	16	9
Chlorate of potash	19	17
5. *Sulphur Compounds.*		
Sulphate of lime	19	9
Protosulphate of iron	15	7
Bisulphite of lime	18	11
Hyposulphite of soda	18	11
6. *Phosphates.*		
Phosphate of soda	17	13
Phosphate of lime	22	7
7.		
Permanganate of potash ..	22	9
8. *Tar Series.*		
Carbolic acid	None	None
Cresylic acid	None	None
9. *Sulphocarbolates.*		
Sulphocarbolate of potash ..	17	18
Sulphocarbolate of soda ..	19	18
Sulphocarbolate of zinc.. ..	17	None
10.		
Sulphate of quinine	None	25
Picric acid	19	17
Pepper	None	8
Turpentine	42	14
11.		
Charcoal	21	9

In comparing the results described in the above Table, the substances can be classed under four distinct heads, viz:—those which prevent the development of protoplasmic and fungus life; those which prevent the production of vibrio life, but do not prevent the appearance of fungus life; those which permit the production of vibrio life, but prevent the appearance of fungus life; and those which do not prevent the appearance of either protoplasmic or fungus life.

The first class contains only two substances, carbolic and cresylic acids.

In the second class, also, there are only two compounds, chloride of zinc and bichloride of mercury.

In the third class there are five substances, lime, sulphate of quinine, pepper, turpentine, and prussic acid.

In the fourth class is included the remaining twenty-five substances.

The acids, while not preventing the production of vibrio life, have a marked tendency to promote the growth of fungus life. This is especially noticeable in the case of sulphuric and acetic acids.

Alkalies, on the contrary, are not favourable to the production of fungus life, but promote the development of vibrios.

The chlorides of zinc and mercury, while completely preventing the development of animalcules, do not entirely prevent fungus life, but I would call special attention to the interesting and unexpected results obtained in the cases of chlorine and bleaching-powder. When used in the proportion above stated they do not prevent the production of vibrio life. In order to do so they must be employed in excess; and I have ascertained, by a distinct series of experiments, that large quantities of bleaching-powder are necessary. I found that part of the carbon was converted into carbonic acid, and part of the nitrogen was liberated.

If, however, the bleaching-powder be not in excess, the animal matter will still readily enter into putrefaction. The assumption on which its employment as a disinfectant has been based, namely, that the affinity of the chlorine for hydrogen is so great as to destroy the germs, is erroneous.

The next class to which I would call attention is the tar series, where neither the carbolic nor the cresylic acid fluids gave any signs of vibrionic or fungus life during the whole eighty days during which the experimett were conducted.

The results obtained with sulphate of quinine, pepper, and turpentine, deserve notice. None of them prevent the development of vibrio life; but sulphate of quinine and pepper entirely prevent the appearance of fungi. This fact, together with the remarkable efficacy of sulphate of quinine in cases of intermittent fever, would lead to the supposition that this class of disease is due to the introduction into the system of fungus-germs; and this is rendered the more probable if we bear in mind that these fevers are prevalent only in low marshy situations, where vegetable decay abounds, and never appear to any extent in dry climates, even in the midst of dense populations, where ventilation is bad, and putrefaction is rife.

The results obtained in the case of charcoal show that it possesses no antiseptic properties, but that it prevents the emanation of putrid gases, owing to its extraordinary porosity, which condenses the gases, thus bringing them into contact with the oxygen of the atmosphere, which is simultaneously condensed.

The above results have been confirmed by a second series.

A series of experiments was also undertaken, substituting gelatine for albumen, and was continued for forty-seven days.

Vibrio appeared in two days in the standard gelatine solution, and bacteria after four or five; and during the whole time of the experiment, life was far more abundant than in the albumen solution. A distinct putrid smell was emitted after twenty-six days.

With bleaching-powder it took twenty days for life to appear, instead of seven, as in the case of albumen; while at no time during the twenty-nine days which remained was life abundant. No putrid odour was emitted; but a mouldy one could be detected on the thirtieth day.

With chlorine solution vibrio life was only observed after forty days; no putrid nor mouldy smell was given off at any time.

The protosulphate of iron gave, with this solution, results quite different from those with albumen, in which, it will be remembered, vibrios appeared in seven days, and fungi after fifteen: whilst, with gelatine, neither protoplasmic nor fungus life appeared during the time the experiments were continued.

Another substance, arsenious acid, also presented a marked difference in its action in the two solutions; for although with albumen twenty-two days elapsed before vibrios were present, and eighteen before fungi, with gelatine animal life appeared after two days, and at no time did any fungi exist. The effects of the other substances with gelatine were so similar to those with albumen that it is unnecessary to state them here.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 21st, 1872.

Dr. Odling, F.R.S., Vice-President, in the Chair.

After the minutes of the preceding meeting had been read and confirmed, and the donations announced, the following names were read for the first time:—Messrs. Thomas Tyrer, George Blundell Longstaff, John Robins, Thomas Roberts Ogilvie, Mark Finch, Arthur John Dickinson, and Frederick William. For the third time—Messrs. George Attwood, Edward Northway Butt, and William Moss Bouron, who were ballotted for and declared duly elected.

When the Chairman had announced that the Faraday lecture would be delivered by Professor Cannizzaro on Thursday, May 30th, the Secretary read a communication from M. Maumené of Paris, which latter stated that the hyponitrous acid discovered by Dr. Divers did not exist, the reaction between the compound NO_3H_2 ($O=8$) and silver nitrate being represented by the equation—

$$17NO_3H_2+4AgONO_5= \\ =4AgO,NO+[4HO+4HONO_5]+13NO_3H_2,$$

since his hypothesis required $n=\frac{170}{40}=4{\cdot}25=\frac{17}{4}$, and concluded by saying that this was one of the numerous instances in which chemists had been led into error by the atomic theory.

From a question put by Dr. **WILLIAMSON** it appeared that M. Maumené's statements were not supported by any analyses or experiments.

Dr. **DIVERS** said that it would, perhaps, be better first to mention something in the history of the research in question. About two years ago M. Fremy published a paper in the *Comptes Rendus* on the reducing action of sodium on nitrites, and a fortnight afterwards a communication from Maumené appeared on the same subject giving better methods, and, at the close, a few lines stating that the action of strong sodium amalgam on nitrites gave ammonia as the principal product, whilst weak amalgam gave the compound NO_3H_2 ($O=8$), a substance possessed of strong reducing powers. Six months afterwards another paper of M. Fremy's was published, in which he acknowledged the help he had received from M. Maumené's researches, but found that oxyammonia was always produced during the reduction of nitrous acid. Subsequently to the publication of the paper in the *Proceedings of the Royal Society*, M. Maumené wrote and asked Dr. Divers very courteously whether he had not anticipated him; he allows the existence of the compound AgNO, but considers it to be a peculiar substance, and not silver hyponitrite. In regard to the equations in his communication to the Society, it must be remembered that he considers the doctrine of substitution of types, of ismorphism, &c., to be false, and a belief in them likely to lead to erroneous deductions, supposing that when the compounds NO_3H_2, and AgO,NO_5 ($O=8$) are mixed in solution, the number of atoms which come in contact are inversely proportional to their equivalents, so that in this case—

$$n=\frac{E}{e}=\frac{170}{40}=\frac{17}{4}$$

that is, 17 atoms of NO_3H_2 ($e=40$) come into contact with 4 atoms AgO,NO_5 ($E=170$), or within the sphere of each other's action, any excess being unacted on, whence his equation—

$$17NO_3H_2+4AgO,NO_5= \\ 4AgO,NO+[4HO+4HONO_5]+13NO_3H_2.$$

One difficulty, however, is how NO_3H_2, which is a neutral compound possessed of no marked properties, can displace nitric acid.

Dr. **ODLING** remarked that we might as well leave out the extra $13NO_3H_2$ from each side of the equation.

Dr. **DIVERS** replied that in this case it would appear to be so, but in the case of copper and sulphuric acid, other compounds besides cupric sulphate and sulphurous anhydride were produced: in the action of chlorine on acetic acid only a certain definite proportion of the latter was converted into chloracetic acid; in the decomposition of lead oxalate by heat, the residue contained two equivalents of lead oxide to one of metallic lead; all these M. Maumené explained by his hypothesis. In the latter case he supposed the lead oxalate, PbO,C_2O_3, to become dissociated on being heated to 350°, and then one molecule of PbO acts on the three C_2O_3, giving rise to metallic lead, 4 of carbonic acid, and two of carbonic oxide, the decomposition taking place thus:—

$$3(PbO,C_2O_3)=2PbO+Pb+4CO_2+4CO,$$

the residue containing metallic lead and lead oxide, and the evolved gases carbonic acid and carbonic oxide, in the proportions indicated. In the case of copper oxalate the decomposition was $2(CuO,C_2O_3)=Cu_2O+3CO_2+CO$, and the residue contains no metallic copper. M. Maumené professes to be able, by his hypothesis, to account for the difference in the decomposition in these two instances. It is possible that these may be merely coincidences, and that the speaker, when he had endeavoured to avail himself of this theory, had failed.

Dr. **ODLING** said that the Society was indebted to M. Maumené for this discussion, and especially to Dr. Divers for his kindly explanation of M. Maumené's views, and for the way in which he had upheld them although opposed to his own, but it must be considered that there are always at first a great number of exceptions to any new theory, which disappear on more accurate investigation. From reading Dr. Divers's paper, he considered he had satisfactorily established the existence of the hyponitrites.

Dr. **DEBUS** then made a communication to the Society. At the last meeting he had made some observations on the "reduction of ethylic oxalate by sodium amalgam," in which he explained he had been induced to undertake to disprove the existence of glycolinic acid by the theoretical consideration that in no organic compound did the number of molecules of hydroxyl, or, as he would prefer to call it, water residue, exceed the number of carbon atoms. Since then he had received a letter from Dr. Wright on this subject, to which he had not had time to reply, and thought the discussion of the apparent exceptions mentioned by him would be interesting to the Society. He desired, in the first place, to make some remarks on the difference between a molecular and an atomic compound. Ferrous sulphate combines with water, giving—

$$[FeSO_4+xH_2O].$$

Now if we attempt to replace the hydrogen in this compound by metals we cannot produce a compound of the same form, but in the case of sulphuric acid, H_2SO_4, the hydrogen can be replaced by metals, alcohol radicals, &c., and these compounds always have the same form as—

$$[H_2SO_4].$$

This is one great point of difference between molecular and atom compounds. Chloral, in contact with water, forms chloral hydrate, $C_2Cl_3HO+H_2O$, from which the water could be removed by treatment with sulphuric acid, and there is no chemical evidence to show that the H_2O is present otherwise than as water of crystallisation, so that even if chloral alcoholate had the composition—

$$CCl_3.CH.HO.EtO,$$

it would be no reason for assigning to chloral hydrate the composition $CCl_3.CH.HO.HO$.

Dr. **WRIGHT** replied that he could not see the difference between what Dr. Debus had termed molecular and atomic compounds, or why the water in crystallised sulphate of copper, for example, should be regarded as different from the water in calcium hydrate, as, in both instances, the water was separated on heating them. In the case of chloral hydrate and alcoholate they were both produced synthetically by similar methods, namely, by the union of chloral and water, or of chloral and alcohol, and since the latter, by the action of phosphoric chloride, was shown to have the composition $CCl_3,CH.(OH)(OEt)$ by analogy, we should consider chloral hydrate as $CCl_3.CH(OH)(OH)$.

Dr. **WILLIAMSON** said the discussion had branched off somewhat from the point from which it had started: what he understood Dr. Debus to mean was that no organic compound existed in which the number of atoms of hydroxyl was greater than the number of carbon atoms, and, as he had before mentioned, the fact that we had been unable to isolate the compound $CO_2(H_2O)$ was a strong confirmation of Dr. Debus's theory. He should himself prefer the terms physical and chemical, in order to distinguish the compounds which Dr. Debus had designated as molecular and atomic; most chemists recognised the difference in the combined water,' although there were instances, like chloral hydrate, which it would be difficult to class, some chemists being inclined to regard it in one light and some in another.

Dr. Debus, in reply to Dr. Wright, said that it was possible to explain the reaction between chloral alcoholate and phosphorous pentachloride on the supposition that the former had the constitution $CCl_3CHO + \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\} O$ ethylic chloride being first formed, which, acting on chloral as it is known to do on aldehyde would give—

$$CCl_3.CHO + C_2H_5Cl.$$

Dr. Odling remarked that he could not call to mind a compound consisting of carbon, hydrogen, and oxygen, in which the number of hydroxyl molecules exceeded those of the carbon; at the same time the difficulty which Dr. Wright had felt in making a distinction between atomic and molecular compounds had also been felt by many other chemists.

The meeting was then adjourned until Saturday, the 30th inst., when the Anniversary Meeting will be held. At the next ordinary meeting, Thursday, April 4th, Dr. Schorlemmer will give a lecture on "The Chemistry of the Hydrocarbons."

ROYAL DUBLIN SOCIETY.

March 18th, 1872.

Mr. John Wigham read a paper at the above Society, "*On the Use of Gas for Lighthouse Illumination.*"

The lecturer stated that coal gas was first used in lighthouses in 1865, by Mr. Samuel Bewley of the Irish Board of Lights, who tried some experiments at Howth. The first burner used was called the "crocus." The principles involved in this burner, and the means taken to economise the gas, proved that by the crocus there was an immense saving, taking light for light, as compared with the gas usually used in our houses. The lecturer then alluded to the economy as compared with oil. There was a saving of about £50 per annum on each lighthouse in which the gas had been tried, and, in the case of intermitting lights, the difference was much greater as regards economy. Dr. Tyndall had been sent down to investigate the whole matter at Howth, and that gentleman had reported favourably. There were five lighthouses at present on the Irish Coast illuminated by gas, and they are about to try it on two of the English lighthouses.

In speaking of the electric light, Mr. Wigham said, that though the latter was very intense, yet it was deficient in quantity, and it was not so good as coal gas for penetrating fogs. Mr. Wigham then proceeded to explain the mechanical arrangements and the construction of the lenses.

CORRESPONDENCE.

THE PRIESTLEY MEMORIAL.

To the Editor of the Chemical News.

Sir,—All who know what Priestley did for science will certainly acknowledge that they who are proposing to honour his name and commemorate his discoveries in a form that will be public and lasting are doing well; but there are many who will be asking whether the form that is proposed be precisely the best.

It is no other than a fact that we do not now in England possess any known sculptor who could give us a statue that would be really worthy or delightful; and, since one that would not be this could only be an excrescence and an eyesore, and would besides lack one attribute which certainly belongs to many of the uglinesses of Birmingham—the attribute of usefulness—why should not the Priestley memorial assume some other form?

Let Priestley's admirers, instead of a statue, set up a thoroughly well-appointed school of science, to be called "The Priestley Institution," or whatever other name be thought fitting. Science, much needed to supplement the technical skill employed in the industries of the Black Country, is not in that district so well provided for as to render the establishment of such a school unneedful. Or, if this undertaking be thought too vast, why not endow, at the Newcastle College or elsewhere, a scholarship of physical science to provide young aspirants from the Midland Counties with the opportunities of scientific practice and culture? The cost of such a scholarship would, I suppose, about equal that of a statue. Or, if this suggestion, again, do not find favour, nor that of a lectureship, surely the ingenuity of the committee can devise some scheme of a similar sort, so that thus the funds subscribed for this memorial are *used for science*, and not thrown away. I am sure there are many who would give their subscriptions all the more cheerfully if, instead of having to see as the result of them an absurd looking old gentleman standing for ever on a pedestal under a Birmingham sky, and making Birmingham more ugly than by man's art it already is, they could have the satisfaction of believing that they were helping to bring out and equip other Dr. Priestleys, or adding to the scanty educational resources of English science.—I am, &c.,

Chemicus.

Bury St. Edmunds,
March 21, 1872.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition o the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk (double number) November and December, 1871.

This number contains the following original papers and memoirs:—

Contribution to the History of Pharmacy.—Dr. J. B. Ullersperger.—This essay is in a measure original, but is based upon the contents of the book entitled "Storia della Farmacia e dei Farmacisti appo i Principali Popoli del Mondo," per Federigo Kernot; Napoli, 1871. It appears from the contents of this memoir that the work just quoted is a very important and well-digested volume.

Contribution to our Knowledge of the so-called False Cinchona Barks.—Dr. F. A. Flückiger.—A valuable pharmacognostical essay, from the contents of which it appears that the name of false (not genuine) has to be modified, inasmuch as certain barks—for instance, the *China alba Payta* and the *China cuprea*—contain the alkaloids of the genuine bark, while the anatomical appearance of the barks is similar to that of the really false (not containing quinine) barks.

Constituents met with in the Dried Cortex Nucum Juglandium.—Dr. T. Koller.—After first referring to the older researches on walnut shell (viz., the outer green shell or rind) of the common walnut, the fruit of the tree botanically known as *Juglans regia*, the author gives a very lengthy and detailed account of his experiments, treating the dried substance first with ether, whereby a quantity of 5·72 per cent of the substance was dissolved; a portion of this quantity was ascertained to be a tannic acid which yields with iron salts a green colour. The residue of the substance, after treatment with ether, was exhausted with alcohol, whereby a quantity amounting to 2·58 per cent was dissolved, chiefly consisting of chlorophyll. The residue, after treatment with alcohol, was digested with water, whereby 9 per cent of the substance was dissolved; starch was not found nor also sugar, but phosphoric acid was found in comparatively large quantity, while also a colouring matter was detected. The residue of this treatment was then first treated with hydrochloric acid, and next with a solution of caustic potassa (1 to 20); this latter solvent acted somewhat upon the pigment present in the rind, which colouring matter was, however, not completely dissolved until after a treatment with a solution of bleaching-powder (1 to 8), when a nearly colourless residue of cellulose was obtained, and an amount of 52 per cent of pigment found to have been dissolved; no alkaloid was found, and, as regards nucine, this is no longer present in the dried rind.

Means of Distinguishing between Fruit and Grape Wine.—Dr. F. Vorwerk.—The main point of interest in this essay is that, according to the author's researches, the phosphoric acid present in genuine grape wine is combined with magnesia, while in fruit wines it is present in combination with lime. The simple addition, therefore, of ammonia 1 part to 9 parts of wine) will produce in genuine wine, after twelve hours' standing, the well-known precipitate of ammonio-phosphate of magnesia.

Contribution to the Chemistry and Physiology of the Agaricus Oreades.—A von Lösecke.—It appears that the sound and freshly-gathered eatable mushroom here alluded to emits, while exposed on a dish standing in a room, hydrocyanic acid in notable quantity, although after having been cooked this cryptogam is not poisonous.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, February 1, 1872.

Newly-Devised Water-Meter.—T. Sibon.—This paper contains very valuable information on water-meters in general, and on a new apparatus of the kind invented by the author.

Analysis of the Mud of the Harbours of Toulon and Rochefort.—Dr. Goussard de Mayolles.—The author analysed these substances with the view of testing their applicability as manures. The composition of the Toulon mud, the sample of which taken at 8 metres below sea-level, was found to be, in 100 parts—Water, 56·18; nitrogenous organic matter, 7·20; phosphate of lime, 6·55; phosphate of magnesia, trace; carbonate of lime, 5·80; carbonate of magnesia, 0·05; sulphate of lime, 2·64; sulphate of magnesia, trace; chloride of sodium, 1·34; alumina and oxide of iron, 0·90; nitrate of potassa, trace; silica and silicates, 19·31; total, 99·97. Rochefort mud, the sample being the uppermost layer of mud, in 100 parts—Water, 49·62; nitrogenous organic matter, 8·11; phosphate of lime, 5·75; phosphate of magnesia, 0·26; carbonate of lime, 8·48; carbonate of magnesia, 0·15; sulphate of lime, 4·12; sulphate of magnesia, 0·05; chloride of sodium, 0·88; alumina and oxide of iron, 1·14; nitrate of potassa, trace; silica and silicates, 11·08. Toulon is situated on the Mediterranean, and Rochefort is at the mouth of the river Charente, not far from the Atlantic Ocean.

Consumption of Gas by the Use of Different Burners and under Different Pressures.—E. Lemoine.—The continuation of an essay on this subject, this portion being illustrated by several woodcuts.

February 8, 1872.

This number does not contain any original papers on chemistry' but we call attention to a short paper, illustrated by a woodcut, and containing a description of a—

Two-Cylinder Steam-Engine with Expansion Gear, and so Constructed as to Require only 2 kilos. of Coal per Horse Power per hour, while at will the two cylinders can be used or only one.—M. Dubuc, C.E.

La Revue Scientifique de la France et de l'Etranger, March 9, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to the following matters of interest:—

Continuation of the Lectures on the Organisation of Armies.—Colonel Usquin.

Physiological Experiments with Animals on the Mode of Action of the Brain.—Dr. Onimus.—Illustrated with woodcuts.

German University of Strasburg, Universitas Argentoratina.—This splendidly endowed institution will be opened on April 1st; as might be expected in a country where the motto "Knowledge is power" is, and has always been, the first requisite for further conquests, everything has been done to make the new university very effective, and the services of a large number of eminent men have been secured; among these we notice—Chemistry, Dr. Bayer; natural philosophy, Dr. Wundt; geology, Dr. Schimper; among the professors of the medical faculty we notice among others the names of Drs. Hoppe-Seyler, Lücke, Schmiedberg, &c.

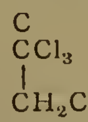
Journal de Pharmacie et de Chimie, February, 1872.

This number does not contain any original papers relating to chemistry.

Zeitschrift für Chemie von Beilstein, No. 17, 1871.

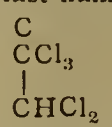
This number contains the following original papers and memoirs:—

Chlorine Substitution-Products of the Ethylic Chloride.—W. Staedel.—After first referring to the researches of other scientific men on this subject, and reviewing what is precisely known on the very large number of the chlorine substitution-products of C_2H_6, the author describes dichlor-ethyl chloride, a liquid boiling at 74°; formula—



$$\begin{array}{l}\mathrm{C}\\ \mathrm{CCl_3}\\ \quad|\\ \mathrm{CH_2Cl}\end{array}$$

and trichlor-ethyl chloride, also a liquid, heavier than water, colourless, smells like chloroform, and boils at 127·5°; with the discovery of this body all the chlorine substitution-products of the ethyl hydrogen *(Æthylwasserstoff)* which can possibly exist are found, and their composition determined, that of the last-named being—



$$\begin{array}{l}\mathrm{C}\\ \mathrm{CCl_3}\\ \quad|\\ \mathrm{CHCl_2}\end{array}$$

Dinitro-Phenols.—H. Hübner and W. Schneider.—In the introduction to this paper, the authors first refer to the researches of Laurent, Griess, Korner, Armstrong, and Schmitt on this subject, and next describe in catalogical manner a series of some twenty different compounds belonging to α series from ortho-nitro-phenol, α series from volatile nitro-phenol, β series from volatile nitro-phenol, and trinitro-phenol from α- and β-dinitro-phenol.

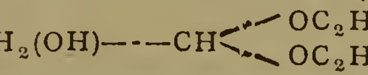
Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 4, 1872.

This number contains the following original papers and memoirs:—

Action of Pentachloride of Phosphorus upon some Aciamides.—Anna Wolkowff.—After first referring to her former researches on the action of chloride of benzoyl upon α and β sulpho-toluolamide, and reminding that the thereby obtained α and β benzoyl-sulpho-toluolamides possess acid properties, yielding salts, $N(C_7H_7SO_2)(C_7H_5O)Mn$, the authoress describes the results of her researches on the action of pentachloride of phosphorus upon the aciamides (so the acids just mentioned have been termed by the authoress) formerly obtained by her. Benzoyl-sulphobenzol-aciamido-chloride, $N(C_6H_5SO_2)(C_7H_5)Cl$, a solid substance, soluble in ether, crystalline, and fusing at from 73° to 75°. Benzoyl-sulphotoluol-aciamido-chloride, $N(C_7H_7SO_2)(C_7H_5)Cl$, also a solid crystalline substance, soluble in ether, decomposed by boiling with water or weak alcohol, and converted into benzoyl-α-sulphotoluol-aciamide; when treated with a solution of carbonate of ammonia, the chloride is converted into the corresponding amide, $[N(C_7H_7SO_2)(C_7H_5)]NH_2$. Benzoyl-α-nitrosulphotoluol-aciamido-chloride, $N[(C_7H_6(NO_2)SO_2](C_7H_5)Cl$, akin to the foregoing, a solid crystalline body, difficultly soluble in boiling ether, and fusing at 125°. Benzoyl-sulpho-cymol-aciamido-chloride, $N(C_{10}H_{13}SO_2)(C_7H_5)Cl$, is a thick oily liquid, which attracts moisture from the air and is converted into a crystalline benzoyl-sulpho-cymol-aciamide. Benzoyl-α-sulphonaphthalin-aciamido-chloride, $N(C_{10}H_7SO_2)(C_7H_5)Cl$, a solid body, crystalline, soluble in ether, fuses at from 92° to 94°, decomposed by boiling water and alcohol, being thereby converted into the corresponding aciamide.

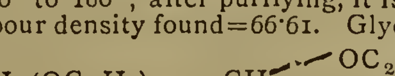
New Method of Decomposition of Rosaniline.—C. Liebermann.—In the introduction to this essay (which is as yet only to be considered as a preliminary notice, the researches not having been quite completed), the author first refers to the labours of Caro, Wanklyn, Fresenius, Dale, Schorlemmer, and Baeyer, on the probability of the existence of a connecting link between the constitution of rosaniline and of rosolic acid, and then states that it occurred to him that possibly water at a higher temperature might eliminate, from rosaniline, the imid group in the shape of ammonia. The author next records at length the results of his experiments in this direction. From these it appears that, at a temperature of from 270° to 280°, water, when acting upon fuchsine in a sealed tube, produces a body which is nearly free from nitrogen (1 per cent only of that element being left); water acting at 235° upon fuchsine produces a substance, $C_{20}H_{18}N_2O.OH_2$, a basic body which combines with platinum chloride.

Some of the Derivatives of Acetal.—A. Pinner.—This exhaustive memoir contains the record of the author's researches on the action of chlorine and bromine upon acetal, the bodies more particularly described being—Monobromacetal—



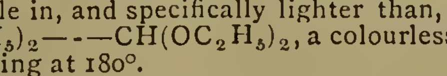
$$CH_2Br{-}{-}{-}CH\begin{cases}OC_2H_5\\OC_2H_5\end{cases}$$

a fluid heavier than water, insoluble therein; is decomposed by distillation, yielding hydrobromic acid; boils at 170°. Glycol-acetal—



$$CH_2(OH){-}{-}{-}CH\begin{cases}OC_2H_5\\OC_2H_5\end{cases}$$

obtained by treating the foregoing compound with alcoholic potassa solution at from 160° to 180°; after purifying, it is a colourless liquid boiling at 167°; vapour density found=66·61. Glycol-acetal ether—



$$CH_2(OC_2H_5){-}{-}{-}CH\begin{cases}OC_2H_5\\OC_2H_5\end{cases}$$

a colourless, agreeably smelling fluid, boiling at 164° without decomposition; insoluble in, and specifically lighter than, water. Glyoxal-acetal, $CH(OC_2H_5)_2{-}{-}{-}CH(OC_2H_5)_2$, a colourless liquid, insoluble in water, and boiling at 180°.

Some of the Derivatives of Chloral.—E. Hagemann.—This extensive essay contains a portion, as yet incomplete, of the author's researches on this subject; but we regret that, notwithstanding the great scientific merits of this paper, its contents are not suited for useful abstraction.

Freezing-Point of Aniline.—E. Lucius.—The author, one of the partners of the celebrated aniline makers and manufacturing chemists' firm of Meister, Lucius, and Brüning, at Höchst, near Frankfort-on-the-Maine, first states that it is generally said in works on chemistry that aniline remains fluid (unfrozen) even at −20°, and that this base is only solidified when exposed to the cold produced by a mixture of ether and solid carbonic acid; yet, during the past winter, a large carboy filled with aniline, and kept in the storehouse of the author's works, was found to be frozen, the cold never having been anything like so intense as to cause the thermometer to be as low as −20°. At first it was thought that the aniline in question contained some impurity, or toluidine; but, on being carefully tested, this turned out differently, and this sample of aniline (boiling at 182°—183°, sp. gr. at 17·5°=1·024) was found to freeze again when cooled down to −8°; and the same result was obtained with several other samples of chemically pure aniline prepared in various ways—as, for instance, from isatine, hydrazobenzol, benzol, and also a sample of aniline (prepared in 1843) from coal-tar, but contaminated with the then unknown picoline. The author accounts for the seldom occurring, or at least observed, freezing of commercial aniline by the facts that, in the first place, it commonly contains fluid toluidine, and secondly, that, as found by him, it (the aniline, more or less pure) may be cooled down very much below −8° before solidifying, but then becomes instantly solid when touched with a solid body, the temperature rising at the same time to −8°.

Chlorated and Iodated Phenyl Oil of Mustard (Senföl).—Sima M. Losanitsch.—This memoir, elucidated by a series of lengthy and complex formulæ, is divided into the following sections:—Chlorphenyl-senföl; iodphenylsenfol.

Compound of Sodium with Glycerine.—E. A. Letts.—The author, formerly a student of King's College, London, gives an interesting and full account of his researches, made in the laboratory of Berlin University under the guidance of Dr. A. W. Hofmann, on the action of sodium upon glycerine, whereby the last-named substance is completely decomposed; but when sodium amalgam is made to act upon glycerine (best, however, by the intermediation of alcohol, sodium alcoholate, and without mercury), there is formed a solid compound, mono-sodium glycerate, a white, pulverulent, very deliquescent body, which may be heated up to 245° without fusing or decomposing, is decomposed by water into sodic hydrate and glycerine, and contains—Carbon, 31·5; hydrogen, 6·1; sodium, 20·1. The author further briefly alludes to his experiments made for the purpose of preparing a cyanogen compound of glycerine by passing chloride of cyanogen over the sodium glycerate alluded to; but respecting this and other researches more complete accounts will be given in the next number.

———

Bulletin Mensuel de la Société Chimique de Paris, July, August, and September (one number), 1871.

In addition to the *procès-verbaux* of the meetings of this Society held in November and December last, this number contains a series of papers, the contents of many of which, as also of the *procès-verbaux*, have been also published in other scientific periodicals and abstracted from these by us. We meet here, however, with the following original memoirs and papers:—

Researches on the Reciprocal Transformation of the Two Allotropic Conditions of Phosphorus.—G. Lemoine.—The complete and exhaustive memoir on this subject (see Chemical News, vol. xxiv., pp. 181 and 204), divided into the following sections:—General introduction; method of experimenting; transformation of red phosphorus; transformation of red phosphorus with the application of a condensing apparatus; experiment made for the purpose of obtaining the two inverse transformations; transformation of ordinary phosphorus; identity of limits by starting from (*en partant de*) the two allotropic conditions.

Oxide of Iron known as Forge-scales, and on the Protochloride of Copper Formed by the Combustion of Copper in Chlorine Gas.—M. Maumené.—The author states that, according to his theory, the composition of forge-scales is—

$$(FeO)_{20}(Fe_2O_3)_2=Fe_{39}O_{47}=Fe_2O_{3\cdot71}.$$

As regards the protochloride of copper, it is stated that when Cu_2Cl is gradually formed in the presence of Cl, there is simultaneously produced an external layer of CuCl; and the two chlorides reacting upon each other, the result is the formation of a compound—

$$3CuCl+2Cu_2Cl=Cu_7Cl_5.$$

Combinations of Sugar and Lime.—P. Horsin-Déon.—The contents of this very lengthy essay record the details of a series of researches on the subject alluded to; but, notwithstanding the great scientific value of this work, its contents are not well suited for any useful abstraction.

Quantitative Estimation of Very Small Quantities of Copper, and on the Presence of that Metal in Cacao Beans and in Chocolate.—E. Duclaux.—The copper is first precipitated from its acid solution by sulphuretted hydrogen, and this sulphuret, having been re-dissolved in a platinum crucible, is next reduced to the metallic state by means of zinc put into contact with the platinum. The author further states at great length that the platinum crucible employed in this operation becomes to some extent converted into an alloy of platinum and hydrogenium, whereby its weight is altered, and that, in order to counterbalance this effect, it is best to wash, after precipitation of the copper, the crucible with alcohol, next dry it at 100°, then ignite it strongly, and lastly weigh it with the copper, which is then removed by some nitric acid. The author has quantitatively tested some nineteen samples in all of cacao beans (*Theobroma cacao*) for the quantity of ash and copper therein contained, observing that, unless the incineration is very complete, the copper is retained tenaciously by the carbonaceous matter. As regards the quantity of copper in 1000 parts of ash, it varies, for cacao beans, from 0·009 to 0·040; for the outer shell (husks) of the same, for 1000 parts, from 0·035 to 0·225; for chocolate of various makers, for 1000 parts, from 0·005 to 0·125.

Preparation and Properties of the Oxide of Triethyl-Phosphine.—J. M. Crafts and R. D. Silva.—The contents of this very lengthy monograph, elucidated by a series of complex formulæ, are, notwithstanding the intrinsic merits, not well suited for any useful abstraction.

Les Mondes, March 14, 1872.

National Observatories.—Under this title we learn that by decree of March 5 last the President of the Republic has approved of the re-organisation of the Observatories of Paris and Marseilles, which, being independent from each other, have been re-constituted, so as to afford scope for astronomical and meteorological studies and observations, as well as physical geography.

Memoir on the Use of Secondary Electric Currents for the Purpose of either Transforming or Accumulating the Effects of a Galvanic Battery.—G. Planté.—Illustrated by woodcuts.

Dynamical Cold-Producing Machine (Réfrigérateur).—J. B. Toselli.—Illustrated with a woodcut. The description of a very ingeniously contrived machine for producing cold by the very rapid evaporation of water.

———

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, December, 1871.

The only original paper relating to physico-chemical sciences contained in this number is an exhaustive memoir—

Caloric Spectrum of Sunlight and of Lime-Light.—Dr. S. Lamansky.

———

Journal für Gasbeleuchtung und Wasserversorgung, No. 3, 1872.

The contents of this number bear strictly upon subjects relating to gas- and water-works' engineering and management.

NOTES AND QUERIES.

Cement—Fractional Distillation.—Would any of your readers kindly oblige me with a receipt for cement to stop cracks in glass vessels, so as to resist moisture and heat? and also say where the most detailed information regarding the fractional distillation of coal naphtha is to be obtained?—C. S.

Steel Manufacture.—Can any reader state what class of manganese ores are preferred by still manufacturers: some ores are much more suitable than others. What foreign matters (if any) act beneficially, and what substances are to be avoided?—Early Subscriber.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.; of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open from 11 to 5 a.m., and and from 7 to 10 p.m. daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For prospectus, &c., apply to Prof. E. V. G., 44, Berners-street, W.

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden.* Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, Kentish Town Road, N.W.

THE CHEMICAL NEWS.

VOL. XXV. No. 645.

WATER ANALYSIS.

FOUR years have now elapsed since Dr. Frankland's method of water analysis was laid before the Chemical Society, and the time has now arrived for the chemists of this country to adopt a decided course in relation to it. As our readers are aware, Dr. Frankland undertakes to deal with the organic matter in drinking-water by burning it and then measuring the resulting nitrogen and carbonic acid. This combustion of organic matter in water differs from the ordinary organic analyses so universally practised by chemists in several important particulars. It is on a very much smaller scale,—instead of 2 or 3 decigrammes of substance, only about as many milligrammes of organic matter are subjected to analysis. Its difficulties are still further enhanced by the circumstance that more than a hundred thousand times as much water as there is organic substance has to be driven off by evaporation in the first stage of the process, and that a quantity of nitrates usually much exceeding the organic matter in amount has to be reduced. Still further to add to the difficulties of the undertaking, Dr. Frankland makes the determination of both carbonic acid and nitrogen in one operation, and not in separate operations as chemists are in the habit of doing.

Before assenting to the results arrived at by a process of this description, chemists required some proof that these great difficulties had been overcome, and were disappointed when they found that Dr. Frankland's experiments on dilute solutions artificially prepared and containing known quantities of various organic substances, exhibited an average error of 0·49 milligramme of "organic nitrogen" in a litre of water—a proportion of organic nitrogen far in excess of that which good drinking-waters contain. Under these circumstances it is not surprising that chemists should be almost unanimous in rejecting the results arrived at by Dr. Frankland's method of water analysis.

If this controversy had arisen in France there would have been a commission of the Academy to report on it. In this country we manage things differently, and resolve questions of this description after our own fashion, and we have to collect the testimony of competent scientific men who live and work in isolation. Mr. Way, who was formerly on the Rivers' Commission, has published his judgment on this question in a report on the analysis of a sample of water. It is to the effect that he uses and has confidence in the rival process of Wanklyn and his colleagues, which, it is admitted, gives results in opposition to Dr. Frankland's. Dr. Angus Smith who, as our readers know, has been for some time engaged in a very important investigation of the organic matter existing in the atmosphere, has also given in his adhesion to the other process, which he employs in his researches. The late Dr. W. A. Miller rejected Dr. Frankland's process and employed Mr. Wanklyn's in his later investigations undertaken for the medical department of the Privy Council. Dr. Voelcker, chemist to the Royal Agricultural Society, rejects Dr. Frankland's process and adopts the other. Dr. Letheby has often expressed a like opinion. Indeed, we scarcely know a single chemist of reputation who approves of Dr. Frankland's water analysis.

Our object in bringing these facts before chemists is that some step may be taken to remedy a state of affairs which certainly ought not to exist. We invite chemists to correspond with us on this subject; and should there be such an agreement among them as to render united action possible, we should advise a resort to the eminently constitutional practice of petitioning Parliament, so as to obtain a uniform statement of results in all the Government water analyses.

ON THE
RELATIVE POWER OF VARIOUS SUBSTANCES IN ARRESTING PUTREFACTION
AND THE
DEVELOPMENT OF PROTOPLASMIC AND FUNGUS LIFE.*

By Dr. F. CRACE CALVERT, F.R.S.

THIS series of experiments was undertaken as being complementary to those described in my last paper, and consisted in adding to a solution of albumen, swarming with microscopic life, one-thousandth part of the substances already enumerated in that paper, and examining the results produced immediately after the addition of the substances, and after one, six, and sixteen days; but in this abstract, only the results obtained in the first and last cases will be noticed.

The solutions were placed in test-tubes similar to those described in my last paper.

The experiments were begun on September 20th, 1871, the solutions being kept at a temperature of 15° to 18° C.

In the standard solution, the amount of life and putrescence increased during the whole of the time.

The first class includes those substances which completely destroyed the locomotive power of the vibrios immediately, and completely prevented their regaining it during the time the experiments were conducted:—

Cresylic acid.

The second class contains those compounds which nearly destroyed the locomotive power of all the vibrios present when added, and afterwards only one or two could be seen swimming about in each field:—

Carbolic acid, sulphate of quinine, chloride of zinc, and sulphuric acid.

The third class are those which acted injuriously on the vibrios on their addition, leaving only a small number retaining the power of swimming, but which allowed the vibrios gradually to increase in number, the fluid, nevertheless, containing less life after sixteen days than the standard putrid albumen solution:—

Picric acid and sulpho-carbolate of zinc.

The fourth class includes those substances which acted injuriously at first, but permitted the vibrios to regain their former locomotive power, and which, after sixteen days, contained as much vibrio-life as the standard putrid albumen:—

Chloride of aluminium, sulphurous acid, and prussic acid.

The fifth class contains those compounds which acted injuriously at first, destroying the locomotive power of most of the vibrios, but which afterwards permitted the vibrios to increase more rapidly than in the standard albumen solution.

Bleaching-powder, bichloride of mercury, chlorine solution, caustic soda, acetic and nitric acids, sulphate of iron, and the sulpho-carbolates of potash and soda.

The sixth class contains those compounds which exercised no action on the animalcules, either at first or after sixteen days:—

Arsenious acid, common salt, chloride of calcium, chlorate of potash, sulphate of lime, bisulphite of lime, hyposulphite of soda, phosphate of lime, turpentine, and pepper.

The seventh class includes those substances which favour the production of animalcules, and promote putrefaction:—

Lime, charcoal, permanganate of potash, phosphate of soda, and ammonia.

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* Abstract of a Paper read before the Royal Society.

ON THE SEPARATION OF POTASH AND SODA.

By TH. SCHLŒSING.

At a recent meeting of the Academy, M. Chevreul dwelt on the difficulties which are met with in the separation of potash and soda; the observations then made by the illustrious chemist will give interest to some researches which I have just made on this subject.

We know that the study of perchlorates led Serullas to adopt a very simple method of estimating potash. Having found that this base is the only one among those most frequently met with in the course of chemical analysis, which forms with perchloric acid a salt insoluble in alcohol, he advises that the bases should be converted into perchlorates, by employing, if necessary, the perchlorates of silver and baryta to eliminate and estimate the chlorine and the sulphuric acid, and to complete the precipitation of the perchlorate of potash by the aid of alcohol of 40° = sp. gr. 0·830. Although adopted at the time of its publication, this method of estimation now seems to have fallen into disuse. Perhaps Serullas was wrong not to quote the results of analysis in figures, this being the most efficient means of establishing the merit of a method; but what has been most wanting in his process is, I think, the reagent on the use of which it is based. Perchloric acid, indeed, has for a long time been only a substance kept for show in our collection of chemicals, and has always hitherto been, moreover, a product of very doubtful purity; and notwithstanding Dr. Roscoe's excellent researches, wherein a method of extracting perchloric acid in pure state from chlorate of potash is described, it has not taken its place among the ordinary chemical products of our laboratories.

I shall now proceed to demonstrate that Serullas's experiment becomes one of the most exact methods of analysis when pure perchloric acid obtained from perchlorate of ammonia is employed. Presently I shall describe a preparation of this salt which will admit of its being readily prepared, so that it may become a mercantile product. Supposing now that I have already obtained it in a pure state, I will first describe its use.

Dr. H. Sainte-Claire Deville has long since taught how to destroy ammonia in analysis by the application of dilute nitro-hydrochloric acid (aqua regia); by this means I convert the perchlorate of ammonia in a few minutes into a mixture of perchloric, nitric, and chlorhydric acids. But by reason of its less degree of volatility and greater chemical energy, perchloric acid completely expels the nitric and chlorhydric acids from their saline combinations; the mixture of the three acids behaves in this respect, and with chlorides and nitrates, like perchloric acid alone, and the bases are therefore converted into perchlorates; provided, however, that the amount present of the acid (perchloric of course) exceeds that of the bases, and provided also that the heat applied be sufficiently strong. It is thus seen that it is useless to use the perchlorates of silver and baryta, as advised by Serullas for the estimation of the chlorine and sulphuric acid. The chloride of barium and the nitrate of silver can here be applied as is usual, since the chlorhydric and nitric acids which they introduce will be afterwards expelled by the perchloric acid.

I now consider a mixture of chlorides or nitrates of potassa or soda. I suppose that the solution has been concentrated on the sand-bath in a small and previously weighed porcelain capsule. Into this the mixture of the three acids is poured, and is then evaporated. When the substance is nearly dry, it gives off a heavy white-coloured mass of vapours; this shows that the perchloric acid is in excess, and that the conversion of the salts is complete. When this evolution ceases, the capsule and contents are left to cool, and the perchlorate of potash is washed several times with small quantities of alcohol at 36° sp. gr. = 0·849, which should be decanted on a little filter for the purpose of retaining thereon the particles of the potassic salt (perchlorate) which are drawn off. The larger the quantity of the soda, the more of it is retained between the crystals of the perchlorate of potash. It is therefore advisable to dissolve the nearly completely washed perchlorate by the aid of heat in the smallest possible quantity of water, and next to evaporate it again to dryness. Two more washings with alcohol then complete the purification of the salt. The perchlorate collected on the small filter is dissolved in a few drops of boiling water, and this solution added to that contained in the capsule again evaporated to dryness and next heated to about 250°. The salt is then entirely desiccated and ready for being weighed. The alcoholic solution of perchlorate of soda is first evaporated in a little flask provided with a long neck, and the salt is next decomposed by heat; then re-dissolved in water and evaporated in a platinum crucible. But the chloride of sodium thus obtained often contains traces of perchlorate; it is better, therefore, to ensure an exact estimation, to convert it into sulphate. Instead of decomposing the perchlorate of soda by heat, it can be treated directly with sulphuric acid by operating in a porcelain vessel.

The following are the results of analysis :—

Operated upon.	Found.
643·2 m.gs. chloride of potassium. 385·5 m.gs. chloride of sodium. Used 2·2 grms. perchlorate of ammonia. ,, 30 c.c. alcohol at 36°.	1193·9 m.gs. perchlorate of potassium = 643·2 m.gs. chloride of potassium. 467·8 m.gs. sulphate of sodium = 385·4 m.gs. of chloride of sodium.
Operated upon.	Found.
35·8 m.gs. chloride of potassium. 1296·7 m.gs. chloride of sodium. Used 3 grms. perchlorate of ammonia. ,, 40 c.c. alcohol at 36°.	64·0 m.gs. perchlorate of potassium = 34·5 m.gs. chloride of potassium. 1294 m.gs. sulphate of sodium = 1570·5 m.gs. of chloride of sodium.
Operated upon.	Found.
777·2 m.gs. chloride of potassium. 2·3 m.gs. chloride of sodium. Used 2 grms. perchlorate of ammonia. ,, 20 c.c. alcohol at 36°.	1143·0 m.gs. perchlorate of potassium = 777·0 m.gs. chloride of potassium. 2·9 m.gs. sulphate of sodium = 2·4 m.gs. chloride of sodium.

It will be seen that the method by perchloric acid permits of the separation of the potash and soda, even when one of the bases is present in a very small quantity as compared with the other. I have even been able to prove, viz., by this process, that my chloride of potassium, although purified by three crystallisations, still contains traces of soda. Indeed, 3·5 grms. of this salt converted into perchlorate left 5 m.gs. of perchlorate of sodium, equivalent to 2·5 m.gs. of chloride of sodium. This soda is not due to, nor derived from, the *vessels*, in which the operations were performed, for an experiment made simply with the reagents did not give any at all.

When the potash and soda are accompanied by sulphuric or any other *fixed* acids, these ought first to be eliminated by the ordinary methods. I have proved that the presence of lime, barytes, and magnesia, does not at all interfere with the correctness of the proper separation of the perchlorate of potash. The following is an example:—

Operated upon.	Milligrammes.
Chloride of potassium	83·5
Sulphate of magnesia	574·0
Chloride of sodium	1298·0
Chloride of calcium	233·0

After the elimination of the sulphuric acid by chloride of barium and conversion of the bases into perchlorates, I find:—

Perchlorate of potassa, 153·1 m.gs. = 82·4 m.gs. of chloride of potassium.

I ought to mention that by this process the separation of the potash may take place nearly at the beginning of an analysis, and thus the method becomes very expeditious when it is only a question of determining this base.

Preparation of the Perchlorate of Ammonia.

It includes three operations:—Preparation of the chlorate of soda; conversion by the aid of heat of the chlorate into perchlorate; next, the conversion of the perchlorate of soda into perchlorate of ammonia by chlorhydrate of ammonia.

The chlorate of soda can be obtained in large quantities either by treating with soda salt (carbonate of soda) the mixture of calcic chloride and chlorate which the solution of hypochlorite of lime yields when it is saturated with chlorine and heated to ebullition, or also by directly saturating the soda salt with chlorine. In several chemical treatises one reads that it is difficult to separate the sodic chloride and chlorate produced at the same time; but this is an error refuted by the following tabulated form:—

	Chlorate of soda.	Chloride of sodium.
100 parts of water dissolve at 12°	89·30	—
100 parts of water at 12°, shaken up with an excess of chlorate and chloride dissolve	50·75	24·4
100 parts of boiling water upon an excess of the two salts at 122°	249·60	11·5
100 parts of this boiling hot solution, cooled down to 12°	68·60	11·5

Whence it is seen that 100 of water saturated at 122° with chlorate in the presence of chloride deposit by cooling 181 of chlorate, and that the common salt remains entirely in solution. Is it not evident from these results that the separation of the two salts presents no difficulty, and enters into the class of operations most familiar to manufacturers of chemical products?

The transformation of the chlorate of soda into perchlorate by heat is similar to that which chlorate of potash undergoes under the same conditions; it even appeared to me to proceed more completely, inasmuch as the evolution of oxygen becomes almost reduced to nought when the saline matter has become of a pasty consistency.

The result of the operation is a mixture of chloride of sodium, with a residue of chlorate, and, further, chiefly perchlorate. It is re-dissolved in the smallest quantity of water; after digestion a syrupy solution of perchlorate is obtained; the greater part of the chloride and chlorate being excluded from it, and remaining in the state of a crystalline precipitate, which is separated by filtration. The solution of the perchlorate mixed with some boiling water, and next saturated with hydrochlorate of ammonia, deposits, on cooling, large crystals of perchlorate of ammonia.

A chemist practising this method on a small scale will lose half of the materials; he will obtain from 250 to 300 grms. of perchlorate of ammonia from 1 kilo. of soda; but in a chemical manufacture, even for very secondary products, the materials are worked up in the proportions best suited to a certain course of operations; the successive saline deposits can be washed methodically and the mother-liquor utilised. When I advocate the use of chlorhydrate of ammonia for the conversion of the perchlorate of soda, it is because the mother-liquor boiled with some carbonate of soda to eliminate the ammonia will contain no other salt but the sodic chloride, chlorate, and perchlorate, and can, therefore, continually be used for dissolving perchlorate of soda afresh.

When the perchlorate of ammonia crystallises in the presence of potassic salts, it carries away some potash, from which it cannot be freed by repeated crystallisations; it is, therefore, absolutely required that the chlorate of soda used in the beginning of the operation be perfectly free from any potash. Its purity should be first tested by the very method of Serullas which I now endeavour to hand over to analysts. A second crystallisation suffices for its purification. In order to test the purity of the perchlorate of ammonia, it should be decomposed by dilute aqua regia, and next evaporated to dryness. No residue whatever ought to be left; the saline mass should completely be volatilised by the heat.—*Comptes Rendus.*

THE REGISTRAR-GENERAL'S REPORTS ON THE LONDON WATERS.

By J. ALFRED WANKLYN.

For the last five years the monthly reports of the quality of the London water supply have included some very extraordinary returns, viz., the proportions of "Previous Sewage Contamination (Estimated)" and of "Organic Carbon" and "Organic Nitrogen" in 100,000 parts of the different London waters.

Although to those chemists who have devoted special attention to the examination of drinking-water the nature of these returns may be pretty well known; yet, for the sake of others who have not so specially occupied themselves with this subject, and for the sake of engineers who refer to these returns hoping for valuable information from them, it may possibly not be useless to discuss them at the present time. "Previous Sewage Contamination (Estimated)" is a term employed by Dr. Frankland, who explained its meaning in a lecture delivered at the Royal Institution in the year 1867. The following are Dr. Frankland's own words:—"With certain corrections presently to be mentioned, the analytical determination of the nitrogen in these salts" (*i.e.* in the solid residue left on evaporating the water) "and in the form of ammonia, unites, as it were, the history of the water as regards its contact with decomposing animal matter. Such *previous organic contamination* may be conveniently expressed in parts of average filtered London sewage, which, if thus completely oxidised in a river, would yield a like amount of nitrogen in the form of nitrites, nitrates, and ammonia. For this purpose average filtered London sewage may be taken as containing 10 parts of combined nitrogen in 100,000 parts, as deduced from the numerous analyses of Way, Hofmann, and Witt. The number so obtained as the *previous sewage contamination* of a water requires, however, a correction, since rain water itself contains combined nitrogen as ammonia, nitrite of ammonia, and nitrate of ammonia." The correction which Dr. Frankland made for rain water was 0·0985 parts of nitrogen in 100,000 parts of water, and if my memory serves me rightly, some slight alteration of the correction has since been proposed. The amount of Previous Sewage Contamination in 100,000 parts of a sample of water is, therefore, found by determining the total nitrogen in 100,000 parts of the water, deducting 0·0985 parts from the total nitrogen, and finally multiplying the result by ten thousand. In this way we were said by Dr. Frankland to attain to an approximate idea of the proportion of sewage originally present in a given specimen of drinking-water.

The annexed is a tabulated statement compiled from the Registrar-General's return for the past year (1871).

Previous Sewage Contamination (Estimated). 1871.

Date.	Chelsea.	West Middlesex.	Southwark and Vauxhall.	Grand Junction.	Lambeth.	New River.	East London.	Kent.
Jan. 4, 16, and 17..	2990	2790	3540	2940	3100	2770	4020	3380
Feb. 8, 14, and 15 ..	3240	3590	3600	3620	3220	3450	4280	4360
March 9, 10	2320	2410	2150	2540	2280	2410	3000	3630
April 12, 13 and 15 ..	1470	1510	1460	1510	1440	1670	1470	4780
May 8, 9 ..	1750	1660	1810	1680	1990	1760	1470	3300
June 8, 9 ..	1090	970	1080	890	1200	1050	610	3260
July 3, 4 ..	1190	430	720	630	1140	1220	500	4100
September 4	420	420	410	460	610	1120	0	3460
Oct. 10, 11..	2490	1400	1420	1370	1390	2380	2290	3060
Nov. 13, 14, and 17 ..	1600	1860	1790	1980	2040	1890	1460	3470
Dec. 7, 8 ..	2270	2250	2270	2270	2460	2320	1480	4470

These figures profess to express the number of lbs. of average London sewage (or of the equivalent) which 100,000 lbs. of each of the above-named waters had received respectively.

Here, perhaps, we ought to say that from inspection of the Registrar-General's tables it appears that the nitrogen present as nitrates and nitrites is selected instead of the total nitrogen, and the correction 0·032 instead of 0·0985 for rain water is employed. Be this, however, as it may, we have copied the official returns exactly.

On turning to the table it will be observed that in September East London water showed zero as its Previous Sewage Contamination, and in October 2290, that is to say that 100,000 lbs. of this water had in September received no sewage at all, and in October 2290 lbs. of sewage. Obviously this cannot be true. Returning to Dr. Frankland's lecture in the year 1867, we find that occurrences of this kind were contemplated (*vide* the following):—"As summer advances and aquatic vegetation becomes vigorous in the bed of the Thames and its tributaries this coincidence of calculated and analytical results will doubtless be disturbed, as the water plants can scarcely fail to withdraw an appreciable amount of nitrates and nitrites from the water, thus diminishing the amount of combined nitrogen, and consequently of previous sewage contamination as determined by analysis."

It is a most extraordinary psychological fact that the author of that passage should have failed to see that if the influence of aquatic vegetation is so overwhelming that the same water-supply contains one month 0·017 of nitrogen (from nitrates) and the following month only 0·260 of nitrogen, the fluctuations in the nitrogen are measures of the activity of vegetation rather than of previous sewage contamination. In reference to this subject the *British Medical Journal* has very aptly observed that if Dr. Frankland were to endeavour to ascertain the relative wages of several workmen by counting their money at the expiration of the week he would exemplify his method of determining Previous Sewage Contamination.

In truth, if we determine the amount of nitrates in 100,000 parts of water and deduct from that the amount of nitrates present in average rain water, we get a number which means nothing in particular, and which certainly is no index to the goodness or badness of the water. It is high time that the Registrar-General of Great Britain should cease stultifying the national statistics by so ridiculous a return.

ASSAY OF IRON ORES.

By T. M. BLOSSOM, E.M.,
Assistant in Charge of the Assay Laboratory of the School of Mines, Columbia College.

The oxides and carbonates are the only minerals of iron which can be used as ores in the blast-furnace. These are associated with different impurities or foreign materials in greater or less proportion. The following is a list of the principal ores of iron, with the maximum percentage of metallic iron that could occur in each, if it were absolutely pure, as in its formula:—

Magnetic iron ore	Fe_3O_4	72·41
Red hæmatite and specular ore	Fe_2O_3	70·00
Brown hæmatite, limonite	$2Fe_2O_3,3HO$	59·92
Spathic iron ore	$FeO,CO2$	48·22
Ilmenite, titaniferous ore ..	$FeO,TiO_2+nFe_2O_3$	36·82
Franklinite ..	$3(FeO,ZnO,MnO)+(Fe_2O_3,Mn_2O_3)$,	45·16

It is required, in the assay of an iron ore, to reduce the oxide of iron to the metallic state, or rather that of cast-iron, to collect it in a button, and to form with the foreign materials of the ore—by means of fluxes—a fusible slag that will not retain any of the iron, in combination, or in the form of pellets. The oxide is reduced by charcoal, and we employ for this purpose crucibles lined with charcoal brasque. The brasque has a composition of four parts of finely pulverised charcoal to one part of molasses. This must be thoroughly kneaded until a ball of it made in the hands resists, to a sensible degree, an attempt to pull it apart. The crucibles are packed full by driving the brasque in with a mallet; a conical cavity, of sufficient size for the charge, is then cut out, and the brasque dried in an oven. Care must be taken not to burn the molasses, for the brasque would in that case crumble, and be useless.

These are the best crucibles for iron assays, because they combine the following advantages:—

Being lined with charcoal, none need be mixed with the charge to reduce the oxide, whereas in naked crucibles charcoal must be added, and is liable to prevent the complete collection of the iron in a button by holding little pellets in suspension.

The slag neither adheres to a charcoal lining nor takes up any material from it, while it does adhere to ordinary naked crucibles, and dissolves argillaceous matter from black-lead crucibles. In the former case, then, the slag may be weighed as a verification of the assay, while in the latter this is, of course, impossible.

The lining serves as a support for the crucible, which, under the high heat employed, is very apt to be softened and crushed beneath the weight of the fuel.

The furnace has a cross section of 18 in. × 18 in., and depth to grate-bars 21 inches. Flue 7 in. × 7 in. The fuel used is anthracite.

The Charge.

In making up the charge it is only necessary to consider the materials required as fluxes for the foreign matters of the ores. It may be well to sprinkle a little charcoal into the charge, as a precaution, but *none is absolutely required*. Two cases may arise, in which we have (1) ores of unknown composition, and (2) ores previously analysed. The assay in both cases gives us a clue to the nature of the iron that may be obtained from the ore, and to the character and proportion of the fluxes to be added in the blast-furnace, in order that we may produce a fusible slag free from iron. In the former case we obtain the additional information of the approximate percentage of iron, though the iron assay is seldom, if ever, made for this purpose. Recourse is had to the more accurate chemical analysis,[*] which gives us the exact

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[*] Chemical News, vol. xxiv., p. 292.

proportions of the substances which affect the iron injuriously or otherwise. In all the assays a constant weight of ore, 10 grammes, is taken.

1. *Ores of Unknown Composition.*

In the assay of an ore the composition of which is unknown, we employ one or more preliminary assays, and, if satisfactory results be not obtained from either, we make another assay with a charge modified according to the indications of the preliminary assay. The following charge may be used to advantage in the preliminary assay:—

Preliminary Assay—Charges.

	I.	II.	III.	IV.	
Silica	2·5	1	4·0	2·5—0	grms.
Lime	2·5	4	1·5	2·5—3	,,
Ore	10·0	10	10·0	10·0	,,

1. The first charge is employed for the purer ores, those containing very little gangue, such as some varieties of magnetic ore, red and brown hæmatites, specular and micaceous ores.
2. Ores containing silica; some varieties of brown hæmatite, magnetic ore, &c.
3. Ores containing the carbonates of lime, of magnesia, of protoxide of manganese, &c.; calcareous hæmatites, spathic iron.
4. Ores containing silica and alumina; clay iron-stones, black-band, &c.

The principle involved in all the charges is that of furnishing a base, lime; for an acid, silica; and *vice versa*.

The choice of a charge, therefore, depends on the acid or basic nature of the gangue of the ore. The materials of the gangue might possibly be associated in such proportions as to flux themselves, but this would happen rarely.

Ores containing titanium require the addition of fluorspar to the charge, in quantity varying from 0·5 to 10 grms., according to the amount of titanium present.

2. *Ores Previously Analysed.*

When we know the percentage composition of an ore, it is a very simple matter to calculate a charge for the dry assay. Good results are obtained from a charge so proportionate as to yield a slag corresponding to the following formula of a blast-furnace cinder, as given by Percy:—

$$R_2O_3,SiO_3+2(3RO,SiO_3).$$

R_2O_3 represents alumina, and RO, lime, magnesia, and other bases. Its approximate percentage composition is as follows:—

Silica	38	or about	2½	parts
R_2O_3 (alumina)	15		1	,,
RO (lime, magnesia, &c.) ..	47		3	,,

We have, then, only to establish the latter relation between the component materials of the gangue, to obtain, on fusion, the above slag.

Let us take the following example:—

The Ore contains	P. c.	10 grms. Ore contain.	Required.	Difference to be added.
Silica	1·65	0·165	2·50	2·335 grms.
Alumina ..	1·94	0·194	1·00	0·806 ,,
Lime, MgO, &c.	4·51	0·451	3·00	2·549 ,,

Silica is supplied by ground quartz. For the bases RO represented in the furnace slag and in the ore by lime, magnesia, &c., we add pure unslaked lime. The alumina is added in the form of kaolin, which may be assumed to contain equal parts of alumina and silica. Allowance must be made in adding silica for that introduced with the kaolin.

It happens sometimes that the ore contains more than is required of one of the ingredients of the slag, or the silica introduced with the kaolin may, when added to that already present, increase the quantity beyond the requirement. In either case make up a new slag with the excess. The following is an example of both cases:—

The Ore contains	P. c.	10 grms. Ore contain	Required.	Difference to be added.
Silica	25·96	2·596	2·50	−0·096
Alumina	6·92	0·692	1·00	0·308
Lime, MgO, &c.	7·59	0·759	3·00	2·241

Kaolin ($Al_2O_3.\frac{1}{2},SiO_{2\frac{1}{2}}$) required to furnish 0·308 Al_2O_3 .. .. 0·616

Silica contained in 0·616 kaolin .. .. 0·308
Silica in excess in ore .. .. 6·096

Total excess of silica .. .. .. 0·404

Add fluxes to make up with this excess more slag of composition as above.

	Excess.	Required.	Difference to be added.
Silica	0·404	2·50	2·096
Alumina		1·00	1·000
Lime, mag., &c. ..		3·00	3·000

Kaolin required to furnish 1·00 Al_2O_3 2·000
Silica contained in 2·00 kaolin .. 1·000
Silica to be added, 2·096 − 1·000 .. 1·096

Total material to be added to the charge:—

Silica	.. ..	1·096
Kaolin	.. 0·616 + 2·00	2·616
Lime	.. 2·241 + 3·00	5·241

The charge having been weighed out, it must be thoroughly mixed on glazed paper; after placing it in the crucible, the conical cavity is closed with a piece of charcoal, and the whole top of the crucible is covered with a luting of fire-clay. The latter is mixed with ¼—⅓ part fine sand, and is made plastic with borax water. Hair is sometimes employed to prevent the luting from cracking off when dry; but no trouble is experienced from this source if the luting be properly made and applied. It should not be put on too thick, should be lapped over the edges of the crucible, and thoroughly dried before placing the crucible in the furnace.

Four crucibles are introduced at one time, and rest upon two fire-bricks placed one upon the other, to keep the crucibles in the very midst of the glowing coals. If the crucibles do not rest steadily on the brick, it is well to support them with a little luting, to prevent their being toppled over in the fire. A low fire may be kindled before the introduction of the crucibles, or it may be kindled around them. The fuel is added gradually until it fills the furnace above the tops of the crucibles; the fire is then maintained at its maximum temperature for 2½—3½ hours, according to the refractory nature of the ore. Ores containing much titanium may even require 4 hours, while carbonates containing manganese may fuse well in 2½ hours, or less time. Three hours will generally be sufficient for ores that do not contain much titanium. When the fire has burned out, the bricks and crucibles are removed in one mass, cemented together by the slag of the fuel. The crucibles are detached, and the exteriors broken with a hammer; on inverting and tapping the brasque lining, the slag and the button of cast-iron will fall into the hand, when, if they adhere together, a slight tap will suffice to separate them. Before separation, however, they should be carefully cleansed and weighed; if necessary, the slag may then be broken, and any particles of iron it retains mechanically may be extracted with a magnet. The weight of the iron being deducted from the weight of the slag and button, we obtain the weight of the slag. This ought to approximate closely to the weight of the fluxes introduced and the corresponding material of the ore. If a large amount of iron has combined with the slag, it will be indicated by the excess in weight. Titanium and manganese enter the slag almost completely; hence, if they are present, allowance must be made for them. Duplicate assays are made, and the two results should not differ more than 0·3—0·4 of 1 per cent. The *slag ought to be* well fused, colourless, transparent, and vitreous or white, light-gray, bluish-gray, opaque, and semi-vitreous, resembling porcelain or enamel.

A *good button* will be well formed, and will separate completely from the slag.

If the *metal be of good quality*, the button, when wrapped in a piece of thin tin plate, and struck on the anvil, will flatten slightly before breaking. It ought to be grey or greyish-white, and the grain fine, or tolerably fine. A button of bad iron breaks readily without changing form, sometimes even pulverising: the metal is generally white and crystalline an the surface.

The following are some of the characters that may be observed in slags and their indications with reference to the charge. A perfectly transparent slag of *greenish tint* indicates an excess of silica. A stony rough slag, or one that is crystalline in fracture and dull in lustre, indicates an excess of bases.

If the product, instead of being melted, is only fritted, and contains the reduced iron interspersed as a fine grey powder, both silica and alumina are deficient in the flux, lime and magnesia being in excess. The latter is one of the most refractory substances found in iron ores, and, when present in quantity, requires an addition of both silica and lime. A vesicular slag, with the iron interspersed in malleable scales, indicates the presence in the ore of silicates of iron and manganese, or an excess of silica, which react on the carburetted iron as it forms, producing malleable iron and carbonic acid. This trouble is corrected by the addition of lime.

Manganese in small quantity gives an amethystine tint to the slag; in larger proportion it produces a yellow, green, or brown colour.

Titanium often produces a resinous, black, and scoriaceous slag, sometimes curiously wrinkled on the outside. It is covered on the outside with a metallic pellicle of the nitrocyanide of titanium with its characteristic copper colour; sometimes the slag is vitreous and of a bluish tint. *Chromium* gives a dark resinous slag, sometimes surrounded by a thin metallic coating.

The following are some characters of the button dependent on the substances named:—

Phosphorus.—A hard, brittle, white metal, what is known as cold-short.

Sulphur.—A strong, reticulated, mottled structure, and red-short iron.

Manganese.—A button smooth exteriorly, hard and non-graphitic: it breaks under the hammer and presents a white crystalline fracture.

Titanium.—The button is smooth on the outside, and breaks under the hammer with a deep grey fracture, dull or crystalline. It adheres strongly to the slag. The button is covered, sometimes with the nitrocyanide of titanium with its characteristic copper colour. Titanium is said to increase the strength of the metal. It may be present to the extent of 1 per cent.

Chromium.—Sometimes the button is smooth, well fused, with a brilliant crystalline fracture and tin-white colour; at other times it is white, only half fused, or it may even form a spongy mass of a clear grey colour, according to the quantity of chromium contained in the iron. Many alloys of iron and chromium will scratch glass.—*American Chemist.*

CONTRIBUTIONS TO THE HISTORY OF THE OPIUM ALKALOIDS.*

By C. R. A. WRIGHT, D.Sc.,
Lecturer on Chemistry in St. Mary's Hospital Medical School.

PART IV.

I. *On the Action of Hydriodic Acid on Morphia in presence of Phosphorus.*

It has been shown in Part III. of these researches† that when hydriodic acid acts on codeia in presence of phosphorus, a series of products are ultimately obtained which may be considered as formed by the following train of reactions:—

$$\overset{\text{Codeia.}}{C_{18}H_{21}NO_3} \quad + \quad HI = CH_3I \quad + \quad \overset{\text{Morphia.}}{C_{17}H_{19}NO_3},$$

$$\overset{\text{Morphia.}}{C_{17}H_{19}NO_3} \quad + \quad 2HI \quad = \quad I_2 \quad + \quad \overset{\text{Hypothetical new base X.}}{C_{17}H_{21}NO_3},$$

$$\overset{\text{Hypothetical new base X.}}{C_{17}H_{21}NO_3} \quad + \quad 2HI \quad = \quad I_2 \quad + \quad H_2O + \overset{\text{Hypothetical new base X}}{C_{17}H_{21}NO_2}.$$

These two hypothetical bases, X and Y, then serve as the foundations of two series of new products expressible by the general formulæ:—

$$4X + nHI \pm pH_2O,$$
$$4Y + nHI \pm pH_2O.$$

In accordance with these views, it might be anticipated that, on treating morphia with hydriodic acid and phosphorus, either the same products, or at least products belonging to these same series, would ultimately result, which is in fact the case.

The morphia used in these experiments was presented for the purpose by Messrs. Macfarlane of Edinburgh, to whom the writer has already been so much indebted for similar acts of liberality; the hydriodic acid was prepared as described in Part III., and contained 50 to 55 per cent of HI.

On dissolving morphia by the aid of heat in about four times its weight of this acid, a marked brown colouration is visible, indicating the separation of iodine; on adding phosphorus and continuing to heat, this colour ultimately disappears, a colourless syrupy liquid being obtained, which is freed from amorphous phosphorus and the phosphorous acids produced during the reaction by filtration through asbestos while hot, precipitation by water, &c., precisely as in the case of the similar codeia products. On then treating codeia, one or other of three products appear to be formed, according to the temperature employed, viz.:—

At 100°.. .. .. $4X + 6HI$.
At 110°–115° .. $4X + 6HI - 2H_2O$.
Boiled up to 130° $4Y + 6HI - 2H_2O$.

In the case of morphia, however, the resulting product is the same at whatever of these temperatures the reaction ensues, and has the composition $4X + 6HI - 2H_2O$. Thus the following numbers were obtained after complete drying at 100°:—

(A). Digested four hours at 100°.
0·3695 grm. gave 0·5920 CO_2 and 0·1710 H_2O.
0·3325 ,, 0·2410 AgI.

(B). Gently boiled ten minutes.
0·3955 grm. gave 0·6240 CO_2 and 0·1770 H_2O.
0·3465 ,, 0·2530 AgI.
0·4420 ,, 0·3260 AgI.

(C). Boiled till the thermometer stood at 132°.
0·3150 grm. gave 0·4990 CO_2 and 0·1400 H_2O.
0·4405 ,, 0·3280 AgI.

	Calculated.		Found. A.	Found. B.	Found. C.	Mean.
C_{68}	816	43·40	43·69	43·03	43·20	43·31
H_{86}	86	4·58	5·14	4·97	4·94	5·02
I_6	762	40·53	39·17	39·46 39·86	40·24	39·68
N_4	56	2·98				
O_{10}	160	8·51				
	1880	100·00				

$C_{68}H_{82}I_2N_4O_{10},4HI$

Hence this product is found from morphia in accordance with the equation

$$4C_{17}H_{19}NO_3 + 14HI = 2H_2O + 4I_2 + C_{68}H_{82}I_2N_4O_{10},4HI.$$

In physical properties and qualitative reactions the substance thus got is indistinguishable from the product of the same composition obtained from codeia; like the

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* Read before the Royal Society.
† *Proc. Roy. Soc.*, vol. xx., p. 8.

codeia product, too, it loses the elements of HI on long-continued boiling with water.

II. *Action of Water on the foregoing Compounds.*

When the original substance $C_{68}H_{82}I_2N_4O_{10},4HI$ is boiled for five hours with about three hundred times its weight of water, a liquid is obtained from which white flakes separate on cooling; these have the same curious microscopical structure as the body similarly obtained from codeia, and gave the following numbers after drying at 100°:—

0·3680 grm. gave 0·6220 CO_2 and 0·1770 H_2O.
0·4240 ,, 0·7165 CO_2 and 0·2050 H_2O.
0·3780 ,, 0·2520 AgI.

	Calculated.		Found.	
C_{68}	816	46·58	46·10	46·09
H_{85}	85	4·85	5·34	5·37
I_5	635	36·24	36·02	
N_4	56	3·20		
O_{10}	160	9·19		
$C_{68}H_{81}IN_4O_{10},4HI$	1760	100·00		

Hence this substance is formed by the reaction

$$C_{68}H_{82}I_2N_4O_{10},4HI=HI+C_{68}H_{81}IN_4O_{10},4HI,$$

identical with that which takes place with the corresponding compound in the codeia series.

When the compound $C_{68}H_{81}IN_4O_{10},4HI$ from codeia is further treated with excess of water and boiled for several hours, a further elimination of the elements of HI has been shown to take place, the end product having the composition $C_{68}H_{80}N_4O_{10},4HI$; as stated in Part III., however, it is very difficult to push this reaction to its extreme. Precisely the same facts are observable with the above morphia product; by boiling this with three hundred times its weight of water for three hours, half the basic iodine it contains is eliminated as HI, forming a product which may be either a mixture of equivalent quantities of $C_{68}H_{81}IN_4O_{10},4HI$ and $C_{68}H_{80}N_4O_{10},4HI$, or a single substance of the formula $C_{136}H_{161}IN_4O_{10},8HI$. If this latter be the case, the formulæ hitherto attributed to the derivatives from codeia and morphia obtained by the action of HI are only half the true ones; and the formation of this substance may be expressed by the equations

$$C_{136}H_{164}I_4N_8O_{20},8HI=2HI+C_{136}H_{162}I_2N_8O_{20},8HI,$$
$$C_{136}H_{162}I_2N_8O_{20},8HI= HI+C_{136}H_{161}IN_8O_{20},8HI.$$

The following considerations tend to show that this body is a single substance and not a mixture:—

1st. By treating the compound hitherto described as $C_{68}H_{81}IN_4O_{10},4HI$ from codeia with water, a body which has the composition of $C_{136}H_{161}IN_8O_{20},8HI$ is produced previously to the production of the substance hitherto described as $C_{68}H_{80}N_4O_{10},4HI$. Now it is not probable that in two separate instances *one* compound should split up into mixtures of *two* bodies of analogous though slightly different constitutions, these two being formed in each case in *equivalent quantities*.

2nd. A body which is without doubt a single compound and which has the formula $C_{136}H_{153}IN_8O_{20},8HI$, has been produced (as will be described in a subsequent communication) by the simultaneous action of HI and P on a polyamide of codeia obtained from that base by the action of phosphoric acid; in physical and chemical properties this product much resembles the two bodies thus obtained from morphia and codeia products by the action of water; and hence these two bodies probably contain, like it, C_{136} associated with I in the base.

In order to show the resemblance between, or rather the identity of, the codeia and morphia products, the formulæ given in Part III. have been adopted in this paper (viz., those containing C_{68}); but the author has no doubt that each of the substances has really double the formula ascribed to it (*i.e.* that each contains C_{136}).

The substances of compositions $C_{136}H_{161}IN_8O_{20},8HI$ obtained as above-mentioned from codeia and morphia products by the continued action of water gave the following numbers on analysis after drying at 100°:—

A. Codeia product—
0·3985 grm. gave 0·7050 CO_2 and 0·200 H_2O.
0·3670 ,, 0·2280 AgI.

B. Morphia product—
0·3120 grm. gave 0·5635 CO_2 and 0·1610 H_2O.
0·3140 ,, 0·5560 CO_2 and 0·1570 H_2O.
0·2840 ,, 0·1775 AgI.

	Calculated.		Found.		
			A.	B.	
C_{136}	1632	48·34	48·25	48·17	48·29
H_{161}	169	5·01	5·55	5·61	5·55
I_9	1143	33·86	33·57	33·77	
N_8	112	3·31			
O_{20}	320	9·48			
$C_{136}H_{161}IN_8O_{20},8HI$	3376	100·00			

In physical character and chemical deportment the derivatives from morphia obtained as above described are indistinguishable from those of the same composition obtained from codeia. The physiological experiments of Mr. Stocker given in the next section show that no particular difference is discernible in this respect also; hence it is concluded that the codeia products are not merely isomeric, but are identical with the corresponding morphia derivatives.

From the fact that hydriodic acid alone does not eliminate methyl from codeia in the form of methyl iodide, but causes the separation of free iodine, it appears more probable that the formation of the compound $C_{68}H_{82}I_2N_4O_{10},4HI$ obtained by the action of hydriodic acid in presence of the phosphorus on codeia is brought about in accordance with the equations:—

$$(1).\ 4C_{18}H_{21}NO_3+14HI=$$
$$=4I_2+2H_2O+C_{72}H_{90}I_2N_4O_{10},4HI,$$
$$(2).\ C_{72}H_{90}I_2N_4O_{10},4HI+4HI=$$
$$=4CH_3I+C_{68}H_{82}I_2N_4O_{10},4HI,$$

rather than the equations—

$$(3).\ C_{18}H_{21}NO_3+HI=CH_3I+C_{17}H_{19}NO_3,$$
$$(4).\ C_{17}H_{19}NO_3+2HI=I_2+C_{17}H_{21}NO_3,$$
$$(5).\ 4C_{17}H_{21}NO_3+6HI=2H_2O+C_{68}H_{82}I_2N_4O_{10},4HI;$$

i.e., that the action does *not* consist in the production of morphia from codeia and its subsequent alteration by addition of H_2, polymerisation, addition of 2HI, and subtraction of $2H_2O$; but that these alterations take place in the codeia molecule before the elimination of methyl as CH_3I, this elimination forming the last stage instead of the first; this circumstance may account for the non-production from morphia of compounds belonging to the series $4Y+nHI\pm pH_2O$, which are formed from codeia when the temperature of the reaction reaches 130°, and under other circumstances; for it might naturally be expected that the elimination of the methyl group would place a portion of the molecule in a quasi-nascent condition, thereby rendering further changes more easy.

The foregoing experiments, taken into consideration with the late Dr. Matthiessen,* lead to several noteworthy conclusions and speculations.

(1). The actions of hydrochloric, hydrobromic, and hydriodic acids on morphia and codeia are not precisely analogous; thus the action of HCl appears to give rise more especially to products derived from non-polymerised bases; *e.g.*, chlorocodide, which regenerates ordinary codeia by the action of water.† By the action of HBr,

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* Matthiessen and Wright, *Proc. Roy. Soc.*, vol. xvii., pp. 455, 460; and vol. xviii., p. 83.

† Experiments are in progress which appear to show that the action of HCl on both codeia and morphia is capable of giving rise, when pushed to an extreme, of bases insoluble in ether, and of characters similar to chloro- and bromo-tetracodeia, with less ease, however, than HBr.

codeia yields not only bases apparently formed from non-polymerised codeia (bromocodide, deoxycodeia, deoxymorphia), but also bases derived from polymerised codeia and accordingly containing at least C_{72}, and probably C_{144} (chloro- and bromo-tetracodeia). Hydriodic acid, on the other hand, yields no body whose formula can be written as containing less carbon than C_{34}, and from the physical characters of the first products of the action and the constitution of their derivatives (many of which contain at least C_{68} and some apparently C_{136}), this proportion of carbon must certainly be doubled and probably quadrupled.

Hence HCl yields single molecule derivatives chiefly; HBr yields single molecule derivatives, and also polymeride derivatives, the polymerides containing at least C_{68} or C_{72} (possibly the formulæ attributed to bromotetracodeia and analogous bases may require doubling, as the physical character of the bases and other salts indicate that they belong to the same rank as the iodine derivatives); HI yields polymeride derivatives only.

(2). It being assumed that the molecules of codeia and morphia contain respectively either C_{18} and C_{17} or C_{36} and C_{34} (which latter is probably the case, experiments now in progress indicating that the molecular formulæ of these bases are double those usually ascribed to them), the above experiments lead to the conclusion that there exist polymerides of these alkaloids containing C_{72} C_{144}, ..., or C_{68}, C_{136}, ..., these polymerides being formed by the action of strong acids, and serving as starting-points for new series of derivatives; experiments to obtain these polymerides in an unaltered condition are, as has been previously stated, in progress, and apparently with success.

This facile disposition to form polymerides is not an unknown feature in alkaloids, the experiments of Anderson having shown that the pyridine bases are characterised by this property; this fact would appear to warrant the speculation that morphia and codeia contain carbon groups analogous to, if not identical with, those contained in the pyridine bases; and, in fact, experiments now in progress, in conjunction with Herr L. Mayer, apparently lead to the conclusion that pyridine is obtainable from morphia derivatives by treatment which, though energetic, is nevertheless far short of destructive distillation: indeed it may be doubted whether the carbon groups contained in the pyridine series of bases do not pre-exist in the bodies from which these bases are obtained by destructive distillation.

(3). A comparison between the formulæ of the products obtained by the three hydracids HCl, HBr, and HI shows that while the action of HCl is simply to replace OH by Cl, or to remove the elements of H_2O (sometimes also replacing CH_3 by H), that of HBr is (in addition to the changes produced by HCl) to cause the addition of hydrogen to that one of the two resulting products that is derived from the non-polymerised molecule. Thus—

HCl and codeia give $C_{17}H_{17}NO_2$, apomorphia,
HBr ,, ,, $C_{17}H_{19}NO_2$, deoxymorphia,

which may be represented as $C_{17}H_{19}NO_3 - H_2O + H_2$.

This hydrogenising action is carried still further in the case of the derivatives obtained by HI; thus the expressions

$$4C_{17}H_{19}NO_3 - 2H_2O + 2HI + H_8,$$
$$4C_{17}H_{19}NO_3 - 6H_2O + 2HI + H_{16}$$

represent the composition of the bases obtained respectively from morphia and codeia at 130°.

(4). Codeia appears to be a species of methylic ether of morphia, their relative constitutions being probably

$$C_{17}H_{17}NO\left\{\begin{matrix}OH\\OCH_3\end{matrix}\right. \text{ and } C_{17}H_{17}NO\left\{\begin{matrix}OH\\OH\end{matrix}\right.$$

(doubling the formulæ will not alter their relations in this respect). Adhering to the formula hitherto employed, the production of the same apomorphia from both alkaloids is readily accounted for thus:—

$$\overset{\text{Codeia.}}{C_{17}H_{17}NO\left\{\begin{matrix}OH\\O.CH_3\end{matrix}\right.} + HCl = \overset{\text{Chlorocodide.}}{C_{17}H_{17}NO\left\{\begin{matrix}Cl\\O.CH_3\end{matrix}\right.} + H_2O,$$

$$\overset{\text{Chlorocodide.}}{C_{17}H_{17}NO\left\{\begin{matrix}Cl\\O.CH_3\end{matrix} = \begin{matrix}Cl\\CH_3\end{matrix}\right\}} + \overset{\text{Apomorphia.}}{C_{17}H_{17}NO\left\{O''\right.},$$

$$\overset{\text{Morphia.}}{C_{17}H_{17}NO\left\{\begin{matrix}OH\\OH\end{matrix}\right.} = H_2O + \overset{\text{Apomorphia.}}{C_{17}H_{17}NO\left\{O''\right.}.$$

According to this view morphia should contain two hydroxyl groups for every C_{17}, and codeia only one. Experiments are contemplated, with reference to this point, on the action of aniline, acetyl chloride, and glacial acetic acid, and on these alkaloids, whereby it is hoped that definite information may be gained as to the presence, or otherwise, and the number of the groups CHO (aldehyde group), OH, &c.

(5). It appears not improbable that codeia and morphia may contain in their molecules benzine residues. Schiff has pointed out* that phenols give colourations with ferric chloride, whereas the corresponding ethers or anisols do not do so; the well-known distinction between morphia and codeia in this respect, therefore, gives some support to the idea that both may be benzine derivatives.

III. *On the Physiological Action of some of the foregoing Derivatives.* By REGINALD STOCKER, M.B., Pathologist in St. Mary's Hospital Medical School.

Doses of 1 decigramme of the compound

$$C_{68}H_{81}IN_4O_{10},4HI$$

from codeia, and of the similar compound from morphia, were given to an adult terrier by the mouth without producing any perceptible effect whatever; when the dose was increased to 3 decigrammes, in each case repeated defæcation in the course of a few hours was produced, the stools being more loose than ordinarily and frequently of a dark greenish colour; no other symptom was noticeable, and no appreciable difference in the action of the two compounds was perceptible.

Doses of 5 decigrammes of the compound

$$C_{68}H_{82}I_2N_4O_{10},4HI$$

from each of these sources were given to the same dog by the mouth with the result of producing similar repeated defæcation in the course of two or three hours; the sole difference discernible between these and the former experiments being that the effect was produced somewhat sooner and was of longer continuance in the latter cases, a result probably produced solely by the larger dose. No material differences were observed between the codeia and morphia derivative.

The same dog was employed throughout, two or three days being allowed to intervene between each experiment, so that the animal had recovered from the effects of a former dose before the administration of another.

It would hence appear that the derivatives of polymerised $C_{17}H_{21}NO_3$ are less active than those of polymerised $C_{17}H_{19}NO_3$; and also that there is no reason for considering the derivatives from codeia as different from those of morphia, the corresponding bodies having respectively the same quantitative composition and the same physical, chemical, and physiological properties.

ON SOME NEW DERIVATIVES OF ALBUMEN.

By O. LOEW.

Additional Note.

SINCE my last communication, I have made some further investigations in regard to the reduction of the hexanitro-albumen-sulphonic acid. I found my supposition confirmed, that all (NO_2) is replaced by (NH_2). After many attempts to isolate the product of reduction, I adopted the following as the best method:—Hexanitro-albumen-sulphonic acid is dissolved in not too great an excess of ammonia, and a current of sulphuretted hydrogen gas passed through it for some time. The solution, saturated

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* *Ann. d. Chem. u. Pharm.*, vol. clix., p. 158.

with sulphuretted hydrogen, is heated in a flask over a water-bath, till all sulphide of ammonia is volatilised (I cannot recommend evaporating in a porcelain dish, because the free access of air would effect an oxidation of the newly-formed product). The fluid is then filtered from the deposit of sulphur, and to the filtrate acetic acid is added till the formation of a precipitate ceases; this precipitate is then well washed with water and alcohol, and carefully dried.

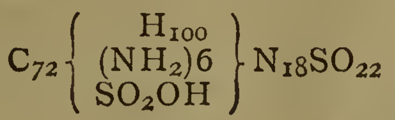
Analysis of this precipitate resulted as follows:—

0·743 grm. gave 0·211 barium sulphate = 3·92 per cent sulphur.

0·248 grm. gave 44·13 c.c. nitrogen, at 14° C. and 7·42 m.m. barometer = 19·02 per cent nitrogen.

0·331 grm. gave 0·584 grm. carbonic acid and 0·203 grm. water = 48·12 per cent carbon, and 6·87 per cent hydrogen.

We have therefore all the (NO_2) here replaced by (NH_2), thus forming the corresponding hexamido-albumen-sulphonic acid:—



$$C_{72}\left\{\begin{matrix} H_{100} \\ (NH_2)6 \\ SO_2OH \end{matrix}\right\}N_{18}SO_{22}$$

	Theory.	Experiment.
C	48·593	48·12
H	6·412	6·87
N	18·897	19·02
S	3·599	3·92
O	22·497	—

This compound is a yellowish-brown powder, almost tasteless, insoluble in dilute acids, soluble in concentrated hydrochloric acid; alkalies dissolve it readily, but on the application of heat a decomposition takes place, with development of ammonia. Nitric acid attacks it with energy, and dissolves it with disengagement of nitrous fumes. I made many attempts to obtain crystalline combinations of this substance, but in vain.

The circumstance that albumen will yield a nitro-derivative, which, upon reduction, is converted into an amido derivative, makes it highly probable that it (albumen) contains radical complexes of the aromatic series. (The formation of tyrosin from albumen leaves this even beyond doubt.) Further investigation will demonstrate which special group in the complex of albumen replaces its hydrogen by (NO_2). Perhaps I shall be able to furnish some information at a future time.—*American Chemist.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, March 30th, 1872.

At this, the thirty-first Anniversary Meeting of the Society, the President, Dr. Frankland, F.R.S., delivered the customary address to the Fellows. This will in due course be printed and circulated amongst the members, whose number at the present time is 656, including 32 foreign members. In the obituary of deceased members whom we have lost during the past year, we may note particularly the names of Fritzche, of St. Petersburgh, Strecker, of Tübingen, and our countryman Sir Roderick Murchison. At the conclusion of the address the President remarked that, however satisfactory the numerical increase of the Society might be, the comparatively small number of original communications sent in, not one-tenth of those of the Berlin Society, was a sign of the apathy and lethargy from which chemical science seemed to be suffering in this country; this he attributed, to a great extent, to the universities granting degrees to persons without requiring from them any proof that they are capable of conducting original research. After the Treasurer had read his financial statement, from which we were glad to see that, notwithstanding the very heavy expenses entailed by the new form given to the *Journal* the balance in hand was larger than usual, the balloting for the Officers and Council was proceeded with, Dr. Divers and Dr. Wright acting as scrutators.

The following is a list of the Officers:—

President—E. Frankland, D.C.L., F.R.S.

Vice-Presidents who have filled the office of President—Sir. B. C. Brodie, F.R.S.; Warren de la Rue, Ph.D., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.,; A. W. Williamson, Ph.D., F.R.S.; Col. P. Yorke, F.R.S.

Vice-Presidents—H. Debus, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.,; J. Stenhouse, Ph.D., F.R.S.; and W. J. Russell, Ph.D., and Maxwell Simpson, Ph.D., F.R.S., in place of J. H. Gilbert, Ph.D., F.R.S., and T. Redwood, Ph.D., who retire.

Secretaries—A. Vernon Harcourt, M.A., F.R.S., and W. H. Perkin, F.R.S.

Foreign Secretary—H. Müller, Ph.D., F.R.S.

Treasurer—F. A. Abel, F.R.S.

Other Members of Council—H. Bassett; A. Dupré, Ph.D.; F. Field, F.R.S.; H. McLeod; H. E. Roscoe, Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; A Voelcker, Ph.D., F.R.S.; and A. Crum Brown, D.Sc., Dugald Campbell, G. C. Foster, F.R.S., Hermann Sprengel, Ph.D., Thomas Stevenson, M.D.; the five last being instead of E. Atkinson, Ph.D., C. L. Bloxam, M. Holzmann, Ph.D., E. J. Mills, D.Sc., and W. J. Russell, Ph.D., who retire.

After the names of the Officers and Council for the ensuing year had been announced from the chair, votes of thanks were proposed to the President, to the Officers and Council, to the Auditors, and to the Editor of the *Journal* and Abstractors.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Ordinary Meeting, March 25th, 1872.

Dr. Wallace, F.R.S.E., President, in the Chair.

"*The Metallurgy of Lead,*" by Mr. John Jex Long.

The author read the first part of a paper on this subject, in the course of which he described the operations which he had personally witnessed at the works of the London Lead Mining Company, at Middleton-in-Teesdale, a few miles from Barnard Castle, where the mining operations were commenced about 170 years ago. He explained the geological position of the lead-bearing rocks in Teesdale, describing the direction, extent, and richness of the mines, and their mode of occurrence in flats, pockets, strings, &c. The annual product of the mines referred to is about 2000 tons of metallic lead, containing about 9 ozs. of silver per ton, which is separated in the metallic form by Pattinson's process. Before the company obtained any pecuniary return from the mines they had to expend about £30,000. Mr. Long described his exploration of the Coldberry Mine at Middleton, the mode of working it, and the various mechanical operations by which the mineral is prepared for smelting, and he promised, on a subsequent occasion, to devote the second part of his paper to the consideration of the smelting and refining processes and the extraction of the silver. The paper was profusely illustrated by specimens.

MISCELLANEOUS.

On the Preparation of Anthracen.—This hydrocarbon, which has attained a great importance as material for the artificial preparation of the madder colours, is found in the last products of the distillation of coal-tar, which, under the name of "green grease," are sometimes sold as axle grease. They consist of a heavy oil, some naphthalin, and about 20 per cent of anthracen. In the whole, the amount of anthracen in coal-tar is only from $\frac{3}{4}$ to 1 per cent. In order to separate the oily products from the solid hydrocarbons, this soft mass is introduced into a centrifugal machine; the residue left is heated to about 110° F., and subjected to the action of a hydraulic press. If the crude material is thin, it is best to employ at once a filter press. The resulting mass, which contains about 60 per cent of anthracen, is exhausted with benzole or gasoline, again subjected to the centrifugal machine, in order to separate the last portions from the light oils. There remains a greenish-white, paraffin-like mass of a beautiful crystalline fracture, containing 95 per cent of anthracen, from which, by sublimation, a perfectly pure product having a melting-point of 420° F. can be obtained. Wartha, in the *Mittheilungen der Deutschen Chemischen Gesellschaft*, states that the anthracen may be very conveniently obtained pure, if by means of a blower a strong current of air is directed into the retort while the anthracen is at the boiling-point. The writer of this would remark that years ago, in conjunction with Orazio Lugo, of Baltimore, he purified naphthalin in exactly the same manner. The anthracen thus evaporates in a surprisingly short time, and may be collected in a large tubulated glass balloon, where it is deposited as a pale, yellowish, snow-like mass. It is important that the distillation of the tar be carried only to the point when products of pitch-like consistency begin to pass over. If the distillation be allowed to go further, hydrocarbons with a higher boiling-point will distil, and these can only with difficulty be separated from the anthracen, thus making it unfit for the preparation of colours. This is especially true of the chrysene, which differs from the anthracen by its lesser solubility in sulphide of carbon.—*Prof. Phin, in the Technologist.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Polytechnisches Journal von Dr. E. M. Dingler, second number for February, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences :—

Coking.—C. Balling.—A practical treatise on the best means of preparing coke on the large scale in ovens, and on the most suitable construction of the latter.

Danks's Rotating Puddling-Furnaces.—The detailed description, illustrated by engravings, of a peculiarly constructed puddling-furnace for iron-works.

Talmi Gold.—Dr. C. Winkler.—This lengthy essay contains information on the alloys now frequently employed for making imitation jewellery, also known as Abyssinian gold, with other *aliases*. The author points out that the alloy is not galvanically gilt, but is plated, that is to say, a very thin sheet of gold is made to adhere to a yellow metal (in 100 parts—Copper, 90·74; zinc, 8·33) by rolling the metals together, and afterwards shaping, moulding, and chiselling it by means of steel tools, the amount of gold varying from 1·03 to 0·03 per cent. As regards wear and tear, the author admits that, by careful plating, these articles really answer well.

Report on Berthelot's Memoir on the Power of Gunpowder and other Explosive Substances.—Dr. R. Wagner.—An excellent review and copious well-digested abstract on the memoir edited by Dr. Berthelot at the end of last year under the title "Sur la Force de la Poudre et des Matières Explosives;" Paris, Gauthiers-Villars.

Means of Detecting and Estimating Paraffin Present in Stearine Candles.—M. Hock.—As regards the qualitative testing for stearine, the author recommends Drs. Wagner and Hofmann's method (see Chemical News, vol. xvi., p. 78), but states that it is preferable to saponify the stearic acid first, and then to extract the paraffin from the soap by a suitable solvent, or, better still (also applicable for quantitative purposes), to treat the potassa-soap with common salt, whereby a soda-soap is formed, which is next dissolved in water, leaving the granules and grains of paraffin free.

Nägeli's Wort-Cooling Apparatus.—A. Nägeli.—Illustrated with engravings. An apparatus constructed upon the plan of Liebig's condenser, very efficient in action, inexpensive, and readily kept sweet and clean.

American Journal of Pharmacy, March, 1872.

In addition to several valuable original papers more particularly relating to the practice of pharmacy, this number contains the following original papers relating to chemistry :—

Abietene, a New Hydrocarbon.—W. Wenzell.—This hydrocarbon is the product of distillation of the terebinthinate exudation of a coniferous tree indigenous to California, viz., the *Pinus sabiniana*, a tree met with in the dry sides of the foot hills of the Sierra Nevada mountains, and locally known as the nut-pine or digger-pine, owing to the edible quality of its fruit. A gum resin, or rather balsam, is obtained from this tree by incisions made in its wood, and the balsam submitted to distillation almost immediately after having been collected, owing to the great volatility of the hydrocarbon (or essential oil, because abietene really stands in the same relation to the balsam alluded to as oil of turpentine stands to the exudation derived from other *Pinus* species). The crude oil, as usually met with for sale at San Francisco, is a colourless limpid fluid, requiring only to be re-distilled to obtain it quite pure. The commercial article is used under different names—abietine, erasine, theoline, &c.—for the removal of grease and paint from clothing and woven fabrics, and likewise as an efficient substitute for petroleum-benzine. Pure abietine (the commercial article having been ascertained by the author to be a homogeneous liquid) is a colourless fluid, exhibiting a strongly penetrating odour bearing some resemblance to oil of oranges; sp. gr. at 16·5°=0·694: it is very volatile, highly combustible, burning with a brilliant white smokeless flame, almost insoluble in water, and soluble in 5 parts of alcohol at 95 per cent. Abietine is not acted upon by dry hydrochloric acid gas nor by nitric acid (sp. gr. = 1·43) in the cold, but heat being applied a slight reaction took place; neither concentrated sulphuric acid nor potassium act upon this hydrocarbon; when treated with chlorine, abietine is converted into fluid of the consistency of glycerine, insoluble in water, colourless, soluble in warm alcohol, and having a sp. gr.=1·666. Abietine readily dissolves iodine and bromine, and is a powerful solvent for fixed and volatile oils, castor oil excepted, and also Peru balsam and Canada balsam; castor oil is absolutely insoluble in abietene, while, curiously enough, the last-named substance is dissolved by castor oil to some extent. When burned in an ordinary spirit-lamp (such as are used in chemical laboratories) with not too large a flame a brilliant white light is obtained without smoking; the vapour of abietine is a powerful anæsthetic when inhaled, and it has been used with success as an insecticide against moths, &c., when sprinkled in closed receptacles. The ultimate composition of abietene is not stated, but the author points out at some length the differences existing between abietene and terebene (oil of turpentine).

Bromide of Calcium.—J. R. Mercein.—It appears that bromide of calcium is now used in medicine, and it is of importance to prepare it free from uncombined lime; this is effected by the author in the following manner:—5 ozs. of bromine and $2\frac{1}{2}$ pints of water are put into a sufficiently large-sized jar, and a stream of sulphuretted hydrogen slowly passed into this, care being taken to place the end of the delivery-tube so as to touch the surface of the bromine; this operation is continued until all the bromine is taken up, and the resulting liquid is next filtered, for the purpose of removing the sedimentary and suspended sulphur. The filtrate is next gently heated to drive off any trace of S_2O_5, and again filtered; the result is a strong solution of hydrobromic acid, which is next saturated with precipitated carbonate of lime in very slight excess. This solution is again filtered, evaporated upon a water-bath to syrupy consistence, and then stirred until it cools; the result is the obtaining of 6 ounces of bromide of calcium, freely soluble in twice its weight of water, and perfectly free from uncombined line.

Meat and the Methods of Preserving it.—Dr. H. Endemann.—Reserved for full reproduction.

Journal de Pharmacie et de Chimie, March, 1872.

This number contains the following original papers and memoirs :—

Preparation of Ozone in Concentrated State.—A. Houzeau.—After describing at some length an apparatus which the author calls an *ozoniseur*—a glass tube wherein, by means of platinum wires fixed therein, electric sparks can be made to pass in oxygen previously introduced into that tube, the effect being that that gas is converted into ozone—the author next describes a series of experiments made with ozone, to exhibit its action on metallic silver, iodide of potassium, chlorhydric acid, ammonia, sulphuretted hydrogen, phosphuretted hydrogen, and organic substances, including indigo solution.

Report on Digitaline.—Dr. Buignet.—This memoir contains the detailed account of a series of pharmaceutico-chemical experiments on the best method of preparing digitaline from the digitalis herb (*Digitalis purpurea*, foxglove). The main point of interest in this memoir is that the herb contains, in addition to digitaline (the active principle, insoluble in water), also digitaleine, an amorphous bitter-tasted substance, soluble in water, while the author also distinguishes digitine, an amorphous bitter-tasted matter, digitaline in pure state being crystalline; the best method of preparing the latter body for pharmaceutical purposes is described at great length.

Method of Detecting the Adulteration of Wax with Tallow by the Aid of Alcohol.—Dr. Hardy.—The author first prepared pure beef-suet, and carefully determined the specific gravity of this substance, which he found to be 0·8863; next he prepared an alcoholic fluid of such a degree of concentration that a piece of the suet alluded to remained suspended (that is to say, sunk therein to a certain depth, and then remained at rest) in it. This alcohol was found to have a specific gravity of from 0·8882 to 0·8857 (between 71° and 72°); the specific gravity of wax is between 0·962 and 0·963; hence it follows that alcohol at 29° will keep wax suspended. Starting from these data, the author has constructed a tabulated form, by the aid of which it becomes possible to detect adulterations of wax with suet (tallow).

Examination of a Small Sample of a Substance Designated as a Perfume from Ancient Egypt.—Dr. Personne.—The author accidentally obtained a small piece of a chocolate-brown substance, which originally was apparently a paste, but is now hard. On further examination it was found to consist of a lime-soap, mixed with myrrh, olibanum, benzoin, and probably some essential oil. The author states that at the present day there is sold in Egypt as a perfume a substance of similar composition, and locally known as *Bouh Kourre-bare*, which means perfume from the Arabian frontier.

Gazzetta Chimica Italiana, No. 1, 1872.

This number contains the following original papers:—

Researches on Benzilated Phenol.—Dr. E. Paterno.—After first referring to his preliminary researches on this subject (see Chemical News, vol. xxv., p. 22), the author treats in this essay on benzilated phenol, a beautifully white coloured crystalline body, not affected by air nor light, soluble in alcohol, ether, benzine, chloroform, and acetic acid, fuses at 84°, and boils at between 175° and 180°. On being analysed, this body gave results leading to the formula $C_{13}H_{12}O$. The products of the action of various reagents upon this body are described at length, and next benzilated anisol is treated on; this is a fluid boiling at 305°; sp. gr. at 0°—1·0729; miscible with alcohol and ether; formula, $C_{13}H_{14}O$. The action of hydriodic acid on this compound is lastly described at some length, the object being to ascertain whether the benzilated phenol directly obtained is identical with that produced from benzilated anisol by the action of the hydracid just alluded to; the result is identity of the two in all particulars.

Synthesis of Condensed Hydrocarbons.—D. Amato.—This essay treats at great length on certain hydrocarbons, CnH_2n, obtained by the dry distillation of castor oil at temperatures varying from 200° to 320° and higher. Among the purified and analysed compounds thus obtained, the author found the following:—C_7H_{16} and $C_{11}H_{24}$, the former boiling at between 95° and 100°, the latter at between 180° and 185°; another, boiling at from 145° to 150°, in 100 parts—C, 81·7; H, 14·8; boiling at from 160° to 165°, in 100 parts—C, 81·5; H, 15·6; boiling at from 195° to 200°, in 100 parts—C, 82·6; H, 14·7.

Bulletin de la Societé d'Encouragement pour l'Industrie Nationale, February, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to—

Decree of the President of the French Republic Relating to the Warehousing and Wholesale and Retail Sale of Petroleum and Paraffin Oils, Benzoline, and other Essences and Hydrocarbons Used for Domestic or other Purposes.—The contents of this very well and clearly arranged measure of public safety deserve attention also for their practical applicability.

La Revue Scientifique de la France et de l'Etranger, March 16, 1872.

This number does not contain any original papers relating to chemistry.

March 23, 1872.

From a short account of the proceedings of the Chemical Society of Paris, held on the 15th of March last, and here published, we quote the following:—

Detection of the Presence of Nitrobenzol in Essential Oil of Almonds.—E. Bourgoin.—The author adds, to the essential oil of almonds to be tested, one-half of its weight of a solution of caustic potassa. When nitrobenzol is present the mixture becomes green-coloured.

Action of Metallic Silver upon Chloro-Iodide of Ethylen, C_2HClI.—Drs. Friedel and Silva.—The authors placed the compound alluded to along with metallic silver in a sealed tube heated to 160°, with the view to remove the iodine from two molecules of the chloro-iodide, and thus to obtain the normal chloride of butylen according to the formula $2(C_2H_4ClI)+Ag_2=2AgI+C_4H_8Cl_2$); but the reaction does not proceed so, since there is formed only iodide of silver, ethylen, C_2H_4, and chloride of ethylen, $C_2H_4Cl_2$.

Oxidation of Glycerine—Glyceric Acid.—Dr. Jungfleisch.—The author only observes, as regards Dr. Heintz's experiments in this direction, that the formic acid found by the last-named among the products of the oxidation alluded to is very likely due, not to the oxidation of glycerine, but to the dissociation of oxalic acid under the influence of glycerine at the temperature at which Dr. Heintz has experimented.

This number contains, moreover, the following memoirs, to which we call attention:—

The Sun and the Spots on it.—Dr. R. Wolf.—A very excellent paper on this subject containing a great many valuable historical details of phenomena seen on the sun in ages past.

The Jurassic Formation.—Dr. Neumayr.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, February 15, 1872.

This number opens with the first instalment of—

A Lecture on the Services which Chemistry has rendered to Agriculture.—Dr. Barral.—The author, having been appointed Perpetual Secretary to the Central Agricultural Society of France, instead of the late Dr. Payen, has taken this opportunity to enter upon his duties with a very excellent discourse on the subject just named.

New Method of Absorbing Sulphurous Acid Fumes.—M. Cahen.—The author suggests for this purpose the use of peroxide of manganese of low quality. The absorption of the sulphurous acid gas, including that evolved in metallurgical operations, is instantaneous; and if the ensuing manganese salts do not happen to be commercially of use they can be readily, by means of chloride of sodium, converted into hyposulphite of soda and other soda salts.

Improvements in Beet-Root Sugar Manufacture by Diffusion and Maceration.—M. Woestyn.—The description of a new method of operation invented by the author and successfully tried in Russia.

Detection of Acidity in Oils.—A. Rumpler.—The author first prepares chemically pure carbonate of soda, makes a concentrated aqueous solution of it, fills with that solution a test-glass, so as to form a layer of 26 m.m. in height, and next pours the oil to be tested on it and stirs the fluids thoroughly for a few moments. On being left quietly standing the oil should not, at the surface where it touches the soda, exhibit any greasy emulsion; if it does it contains acid, and if the quantity of the latter is somewhat considerable the whole mass becomes so thick that the glass can be turned upside down without the mixture flowing out.

Bulletin de l'Academie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, No 2, 1872.

This number does not contain any original papers relating to chemistry.

Bayerisches Industrie und Gewerbe-Blatt, February, 1872.

This number does not contain any original papers relating to chemistry, but we mention the following subjects:—

Preparation of Meerschaum at Ruhla.—T. Urban.—The contents of this paper treat at length on the manufacture of the meerschaum pipes. It appears that meerschaum is an article of extensive trade, and is also met with in Asia Minor, the Crimea, Spain, and especially near Hrubschitz and Oslowan in Austria. Meerschaum, sepiolite, is a hydrated silicate of magnesia, lighter than water; some kinds of this mineral contain some alumina and oxide of iron.

Regulations to be Complied with for the Safety of the Steam-Boilers and other Steam Apparatus in the Kingdom of Bavaria.—In a very clear and concise manner, this official document sets forth everything which science and sound practice combined can do to render accidents with steam-boilers almost impossible, while no particular burden is thrown on the owners of the same.

NOTES AND QUERIES.

Steel Manufacture.—(Reply to "Early Subscriber.")—Consult the work on "Metallurgy" by the Editor of the Chemical News and Dr. Röhrig, and published by Longmans and Co.

Atmospheric Air.—Can any of your readers inform me on this point? If ordinary atmospheric air be passed through asbestos, is it freed from organic matter, sporules, &c., in the same manner as if passed through cotton-wool?—A Subscriber.

Water Pollution.—Chemical News of last week, p. 145, quotes 0·03 organic nitrogen as maximum impurity correctly from "Public Health Bill," but Rivers' Commission gives 0·3 of organic nitrogen. Probably 0·03 in the above Bill is a mistake for 0·3.—J. Campbell Brown, D.Sc.

Cement—Fractional Distillation.—(Reply to C. S.)—Dissolve caseine in a cold saturated solution of borax, and with this solution paste strips of hog's or bullock's bladder (previously softened in cold water) on to the cracks of the glass. After drying at a very gentle heat this will be found to answer your purpose; and if you want to apply heat to the glass vessel, coat the bladder on the outside before it is quite dry with a paste made of a rather concentrated solution of silicate of soda and quicklime or plaster-of-Paris; but it must be remembered that such a mixture becomes stone-hard, losing its plasticity in a very short time (from one-half to one or two hours, according to the degree of concentration of the silicate solution and the quantity of quicklime or plaster-of-Paris used. As regards the fractional distillation, you will find every information on this subject in "Encyclopédie-Roret. Couleurs d'Aniline d'Acide Phénique et de Naphtaline," vol. i., pp. 100 to 231; consult also the late Mr. Mansfield's papers, published in the *Journal of the Chemical Society*.

MEETINGS FOR THE WEEK.

Monday, April 8th.—Medical, 8.
—— Anthropological, 8.
—— London Institution, 4. Mr. E. J. Hopkins, "On Music."
Tuesday, 9th.—Civil Engineers, 8.
—— Photographic, 8.
—— Royal Institution, 3. Dr. Guy, "On Statistics and Social Science."
Wednesday, 10th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 11th.—London Institution, 7.30.
—— Royal, 8.30.
—— Royal Society Club, 6.
Royal Institution, 3. Dr. Tyndall, "On Heat and Light."
Friday, 12th.—Royal Institution, 9. Mr. John Morley, "On Rousseau's Influence on Thought."
—— Quekett Microscopical Club, 8.
—— Astronomical, 8.
Saturday, 13th.—Royal Institution, 3. Mr. R. A. Proctor, "On Star-Depths."

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G. C.—We would advise you to write to Mr. Oertling; you will see his address in our advertisement pages.

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THE CHEMICAL NEWS.

Vol. XXV. No. 646.

ON PUTREFACTION.*

By Dr. F. CRACE CALVERT, F.R.S.

This paper is intimately connected with those I have already published on protoplasmic life and the influence it effects on putrefaction.

I have already shown that when albumen from a new-laid egg is introduced into *pure distilled water* and communication with the atmosphere prevented, protoplasmic life does not appear. If the same solution, however, be exposed to the atmosphere for fifteen to forty-five minutes, minute globular bodies appear having an independent motion, which I denominate monads. The time required varies according to the time of the year, the amount of moisture present in the atmosphere, and the temperature.

Although M. Pasteur has already noticed the meteorological conditions which influence that life, he has not noticed the extraordinary rapidity with which the fluids are impregnated, and that this impregnation is proportional to the surface exposed.

On the 18th of May, 1871, two portions of albumen, measuring 400 grains, were placed, the one in a test-tube having a diameter of $\frac{3}{4}$ inch, the other in a test-glass which at the surface of the liquid had a diameter of 2 inches. In the tube vibrios appeared after twelve days, whilst in the glass only five days were required for their development. If in place of pure distilled water the water supplied by the Manchester Corporation (which is one of the purest waters in England) be used, the time required for the development of vibrios in a test-tube was only twenty-four hours.

These experiments prove that the rate of development of vibrio life is influenced by the extent of surface exposed.

M. Pasteur has already demonstrated that oxygen is essential to the life of the Mucedines, but I am not aware that it has been proved that this gas is necessary to the existence of vibrio life.

In the hope of throwing some light on this subject, the following experiments were made:—

Into each of five glass bulbs equal volumes of a solution of albumen in Manchester water were placed, and the first left in contact with the atmosphere for twenty-four hours, after which the ends of the tube were hermetically sealed about 2 inches on each side of the bulb. After passing oxygen, hydrogen, nitrogen, and carbonic acid over the other four solutions, the tubes were also hermetically sealed. These tubes were kept closed for twenty-seven days, during which it was observed that the albumen in the bulb containing oxygen speedily became turbid, then the one containing air, while the other three remained clear. After this period the tubes were broken and the contents examined. A large quantity of vibrio life was found in those containing oxygen and common air, whilst those containing nitrogen, carbonic acid, and hydrogen contained very small quantities, that with hydrogen the least. Thus proving that oxygen is an essential element to the production of putrefactive vibrios.

In further support of this view, I may state that under certain conditions these animalcules produce such an amount of carbonic acid and other gases as to exclude oxygen to such an extent that their own development and life are impaired.

This is easily proved by taking albumen full of animalcules, but not emitting any putrid odour, and placing it in test-tubes, closing some and leaving others open. If these tubes are examined after a few weeks, it will be observed that in those left in the air life has much increased, and they emit a very putrid odour; whilst the life in the closed tubes not only has not increased, but appears to be in a dormant condition; for if the corks are removed and the fluid again comes in contact with the oxygen of the air, its activity returns. The albumen also in the closed tubes does not emit any putrid odour.

M. Pasteur has also found that oxygen was necessary to the vibrios of putrefaction, although the same gas destroyed those produced in butyric fermentation; but he has not made any experiments to show that the products emitted by such vibrios are prejudicial to their development, and even to their power of locomotion.

Having stated above that liquids exposed to the atmosphere become impregnated with monads, I will now try to describe their gradual development into vibrios, and their ultimate transformation into microzyma.

A few hours after the albuminous fluid becomes impregnated, the monads, which have a diameter of about $\frac{1}{128000}$th of an inch, appear to form masses. Then some of the monads become elongated into vibrios, which, though attached to the mass, have an independent motion; so that as the force exerted by the vibrios predominates towards one or another direction, so is the mass moved over the field of the microscope. As the development proceeds, the mass is broken up, and ultimately each vibrio has an independent existence, and may be seen swimming or rolling about in the fluid. Their size at this stage is about $\frac{1}{20000}$th of an inch. These, which I call ordinary vibrios, gradually grow into long vibrios, which attain a length of $\frac{1}{6400}$th of an inch.

These long vibrios gradually become changed into cells, which I have called microzyms. The first process in the transformation is its division into two independent bodies. One extremely faint line appears across the centre of the animalcule, and increases in distinctness until the vibrio appears like two smaller vibrios joined together. The separation takes place and each part acquires an independent existence. These parts again divide, and the process of subdivision is carried on until they appear to be nothing more than cells, which have a swimming-power so great as to pass over the field of the microscope with rapidity.

After twelve or eighteen months all the vibrios disappear and are replaced by microzyms, either in motion or at rest. If these microzyms are placed in a solution of fresh albumen, vibrios are abundantly developed. The apparent explanation of this fact is that in the fresh albumen they have all the circumstances favourable to their growth and reproduction, while the putrid albumen has become so completely modified as to be incapable of affording them the requisite conditions for reproduction.

I may also notice that at the same time a deposit has taken place which, under the microscope, appears to consist of shoals of small particles of matter which have no life. The solution has now become perfectly clear, possesses considerable refractive power, and has lost the property of becoming coagulated by heat.

The albumen solution does not emit a putrid odour until after the formation of the above-mentioned deposit, and the amount of odour is in direct ratio to the number of vibrios present.

I remarked during the investigation the presence of several other forms of animalcules which contribute to the decomposition and putrefaction of proteine substances, the description of which will be found in the original memoir.

THE REGISTRAR-GENERAL'S REPORTS ON THE LONDON WATERS.

By J. ALFRED WANKLYN.

Part II.

Before leaving "Previous Sewage Contamination (Estimated)," which has figured in the Registrar-General's Reports ever since the beginning of the year 1867, it may not be amiss to glance at the use to which Dr. Frankland applied this datum.

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* Abstract of a Paper read before the Royal Society.

If the Reports issued in the earlier part of this period be inspected, as, for instance, the table for December, 1867, previous sewage will be found to be zero for Loch Katrine, Lancaster, Manchester, and Leicester, and to stand at 4820 for the Kent water, and at about 2000 for the water of the various Thames Companies. The Registrar-General also says, writing under date December 30th, 1867, "No previous sewage contamination occurred in the waters supplied to Glasgow, Lancaster, Manchester, or Leicester, but the London waters had been more or less contaminated previous to filtration." In fact, the return of Previous Sewage Contamination (Estimated) was connected with the attempt to force what was called pure water from the mountains on the Metropolis; and of late years, since that attempt was seen to be hopeless, the zeros for the Previous Sewage in Glasgow, Lancaster, Manchester, and Leicester have disappeared from the tables.

On comparing Dr. Frankland's Reports of the end of 1867 with Dr. Frankland's Reports of the present time, it will be seen that his analyses of 1867 led him to a conclusion the opposite of that which he now maintains. He used to find Kent water everything that is horrible, and once reported of it that "The use of this water for domestic purposes is very undesirable." Now, as chemists are amused to learn, writing December 28th, 1871, he finds that "if we call the amount of organic impurity in a given volume of the Kent Company's water 1, the proportional amount in an equal volume of water supplied by the other metropolitan companies was—New River, 2; Chelsea and Lambeth, 5·2, &c.;" and, in short, Kent water has now taken that position in his imagination that used to be occupied by the water of Loch Katrine.

Passing on to "organic carbon" and "organic nitrogen," the other novelties introduced into the Registrar-General's Reports, I will be very brief.

In the paper by Chapman, Smith, and myself, published by the Chemical Society in 1868, and never called in question by Dr. Frankland, there is a detailed account of our objections to these determinations of carbon and nitrogen in drinking waters. We have reprinted this paper in the appendix to the two editions of our little book on Water Analysis, in order that chemists intending to adopt Dr. Frankland's method may be warned of its difficulties. If it were certain that the organic matter in water underwent no decomposition during the evaporation of the water to dryness, if the nitrates could be utterly destroyed without damage to the organic matter, and if two or three milligrammes of organic substance were enough for an organic analysis, then Dr. Frankland's results might have some value.

The following table of the organic nitrogen given by the water of the Kent Company during the last four years is compiled from the official returns:—

Organic Nitrogen in 100,000 *parts of Kent Water.*

	1868.	1869.	1870.	1871.
January	0·013	0·013	0·013	0·014
February ..	0·013	0·010	0·010	—
March	0·029	0·017	0·008	0·010
April	0·011	0·012	0·008	0·005
May	0·006	0·008	0·018	0·011
June	0·007	—	0·017	0·007
July	0·009	—	0·009	0·010
August	—	—	0·019	—
September ..	0·007	—	0·017	0·008
October	0·006	—	—	0·012
November ..	0.026	—	0·005	0·013
December ..	0·012	—	0·019	0·008

I was unable to procure the returns for the latter part of 1869, which will explain the occurrence of blanks for that year. For the rest, the blanks exhibited in the above are likewise to be met with in the official return.

Now, it is extremely unlikely that the quality of the Kent water has altered during the last four years, yet we find a variation of from 0·007 to 0·029 in 1868, from 0·005 to 0·019 in 1870, and from 0·005 to 0·013 in 1871. During the whole of this period the Kent water has no doubt been constantly purer than the Thames waters, or than New River water; and yet in March, 1868, the organic nitrogen in it was found higher than in two of the Thames' Companies, or in East London water, or in New River water. In November of the same year, Lambeth water was highest (viz., 0·027 of organic nitrogen), then came Kent water, 0·026, and after it the notorious Southwark and Vauxhall and all the other companies.

ON METASTANNIC ACID AND THE DETECTION AND ESTIMATION OF TIN.[*]

By ALFRED H. ALLEN, F.C.S.

Metastannic acid is generally stated to be insoluble in ordinary acids, though some writers describe it as forming compounds with sulphuric and hydrochloric acids. My results are greatly at variance with the described characters of metastannic acid, as will be seen from the following observations.

Metastannic acid was prepared by oxidising tin by nitric acid, and washing thoroughly by decantation and on the filter. The product was boiled with concentrated hydrochloric acid (sp. gr. 1·11) for some minutes, the liquid decanted from the residue and tested by hydrosulphuric acid. The liquid in every case contained abundance of tin, and when much hydrochloric acid was employed the solution was sometimes nearly perfect. The residue possessed the properties attributed to it by Miller and Fresenius, but its aqueous solution showed far less liability to precipitation by excess of acid than I had expected. Any method of analysis depending on the insolubility of metastannic acid in hydrochloric acid must be utterly worthless.[†] The presence of stannic phosphate or arseniate in no way alters the solubility of metastannic acid, but renders the solution liable to precipitate on addition of water, especially when heated. The residue left when antimony has been oxidised by nitric acid is perfectly soluble in hydrochloric acid, but of course the solution is very readily precipitated by dilution.

Metastannic acid readily and completely dissolves when heated with concentrated sulphuric acid, becoming converted into *ordinary* stannic sulphate, $(\mathrm{Sn}''''(\mathrm{SO}_4)_2)$. If the liquid be poured into cold water, a solution of stannic sulphate is at first obtained, but this quickly deposits some of the tin as *ortho*-stannic hydrate. On boiling the solution of stannic sulphate, the whole of the tin is precipitated as metastannic acid.

Ignited and native stannic oxides are not completely dissolved by hot strong sulphuric acid. Fusion with acid sulphate of potassium acts on them more or less perfectly, and the aqueous solution of the product contains stannic sulphate, giving a precipitate of metastannic acid on boiling. The reaction presents the closest analogy to the decomposition of titanic sulphate by dilution and boiling.

On adding about twice its bulk of hydrochloric acid to the solution of metastannic in sulphuric acid, a solution is formed which will bear considerable dilution without suffering precipitation. This liquid corresponds in every respect to a solution of *ordinary* stannic chloride, and is free from *meta*-chloride.

The residue left on oxidising antimony by nitric acid is readily acted on by strong sulphuric acid; but the solution produced by subsequent treatment with hydrochloric acid is very readily precipitated by water. Of course this can be avoided by addition of tartaric acid. Ignited Sb_2O_4 is not dissolved by heating with sulphuric acid.

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[*] Abstract of a Paper read before the Chemical Society, March 7, 1872.

[†] Fresenius makes use of the supposed insolubility of metastannic acid in hot concentrated hydrochloric acid in his method of "Qualitative Analysis" (7th edition, p. 110).

On making the observation that ordinary stannic sulphate was formed when metastannic acid was heated with concentrated sulphuric acid, the value of the reaction for analytical purposes became at once apparent.

The reaction is especially serviceable in analysing the residue left on dissolving alloys in nitric acid. The following are the details of the method I prefer for the purpose:—

The residue is washed, and heated with concentrated sulphuric acid in moderate quantity until copious fumes of the acid are evolved. The liquid, which should be quite clear, is allowed to cool, and is then treated with two or three times its bulk of concentrated hydrochloric acid, and boiled if not still perfectly clear. The solution is diluted with about an equal bulk of water, and is then ready for examination. Estimation of the metals can be effected by the usual processes. For their detection, I have found the following method preferable. The solution is divided into several portions.

(1). Is tested for antimony with zinc in a platinum vessel, or by heating with a fragment of metallic tin (this precipitates copper also, if present).

(2). Is diluted and tested for iron and copper by potassium ferrocyanide.

(3). Is diluted, treated with tartaric acid, excess of ammonia and "magnesia mixture," stirred, left some hours, and the sides of the vessel carefully examined for streaks of ammonio-magnesium phosphate or arseniate; these, if detected, may be readily distinguished by the method described by me in CHEMICAL NEWS, vol. xxiv., p. 120. Small quantities of arsenic are difficult of detection by magnesium, owing to the solubility of the ammonio-magnesium arseniate in ammoniacal liquids. Direct application of the molybdic acid test to the acid liquid often indicates the phosphate or arseniate when present, but is not to be relied on.

(4). The solution is boiled (without dilution) with a few inches of soft iron wire until colourless. It is then diluted with about two parts of water, and again heated for a few minutes. By this means the tin is completely or partially reduced to the stannous condition, without being precipitated in the metallic state as when zinc is used; the solution decanted from the precipitated antimony (and copper), and the tin at once detected by mercuric chloride (which is not reduced by ferrous chloride), or the brown stannous sulphide may be precipitated by hydrosulphuric acid. Mere traces of tin may be detected in this manner.

The action of nitric acid on alloys of tin and gold produces a beautiful purple residue, which owes its colour to purple of Cassius. This residue, when heated with concentrated sulphuric acid, gives a purple solution, which, on further heating, becomes colourless, the whole of the tin being dissolved and the gold remaining as a heavy brown metallic residue. The purple residue was always washed free from nitric acid. If hydrochloric acid be added before the purple solution has turned colourless, a small quantity of gold remains in permanent solution, probably as chloride. As a precaution against this source of error, if the solution has any yellow tint after addition of hydrochloric acid and an equal bulk of water, it is well to boil with a crystal of ferrous sulphate, which reduces the gold without affecting the stannic solution.

I had hoped from these results to obtain some insight into the obscure constitution of purple of Cassius. If we suppose it to contain $Au_2O_3,3SnO,+4H_2O$, the fact of a purple liquid being formed with sulphuric acid is difficult to understand if the oxides are merely converted into sulphates, as neither auric nor stannic sulphate has a deep colour, and they could scarcely co-exist in a liquid.

If the purple be regarded as containing aurous and stannous stannate $(Au_2{}'SnO_3,Sn''SnO_3+4aq)$, the action of sulphuric acid would probably result in the formation of aurous, stannous, and stannic sulphates—

$$(Au_2{}'SO_4+Sn''SO_4+2Sn''''(SO_4)_2)\,;$$

and at a higher temperature the two first products might easily react to form metallic gold and stannic sulphate, which are undoubtedly the ultimate products.

I have recently shown that auric sulphate is more stable than had been supposed, and, although aurous sulphate has never been obtained, it may possibly exist, and possess a purple colour like the aurous stannate believed to be present in purple of Cassius. Aurous oxide is stated by Figuier to have a violet colour, and to combine with acids. I do not think the purple colour of the sulphuric acid solution can be due to metallic gold in suspension. On dilution with water, the purple is gradually deposited in an apparently unchanged state.

I have found the sulphuric acid method very serviceable for the qualitative and quantitative analysis of dentists' alloys containing gold, silver, and tin. After treating with nitric acid, and thus obtaining the silver in solution, the purple residue is acted on by sulphuric and hydrochloric acids as before described, the gold being weighed direct and the tin estimated by one of the ordinary methods. For this purpose, I prefer to neutralise the free acid, add a moderate excess of sulphuric acid, dilute largely, and boil, when the whole of the tin is thrown down as a white precipitate of metastannic hydrate, which can be readily filtered and washed, and on ignition leaves pure SnO_2.

The purity of the gold was ascertained by dissolving in bromine water, which in every case effected complete solution.

By the above method, all residues left by the action of nitric acid on alloys can be rapidly and accurately analysed in the wet way, thus avoiding all processes of ignition or fusion.

Sheffield, February 16, 1872.

THE STATE OF COMBINATION OF SILICIC AND CARBONIC ACIDS IN WATER.[*]

By EDWARD NICHOLSON, Assist. Surg. R.A.,
Analyst of Waters, Mysore, Northern, and Ceded Districts.

It is generally assumed that in a natural water all the bases not combined with sulphuric acid, chlorine, and nitric acid, are in the state of carbonates, probably as bicarbonates in the case of potassium and sodium, certainly so in the case of calcium and magnesium. In the statement of analyses, when a formula is given for the saline combinations considered to be present, it is usual to leave silica and alumina uncombined; iron is also often left uncombined, as peroxide, though it is sometimes shown combined either as ferrous carbonate or as ferric phosphate. The reason of this hesitation regarding silica and alumina, is that the amount present in the waters of Europe is generally so small that it is considered not worth while risking a hazardous formula in the case of constituents of such doubtful status. The quantity of silica found in waters of the continent of Europe rarely exceeds 5 centigrms. per litre[†], except in the case of three or four mineral springs; and in England the quantities recorded are still smaller. As an example of a calcareous water, that of the river Thames, according to two standard analyses, contains 1·01 to 1·13 centigrms. per litre; the waters of the rivers Don and Dee, in a granitic district, contain 4·85 and 0·20 centigrm. per litre, respectively. Alumina has rarely been noted in English waters in any quantity above a trace; in some continental waters, and in some chalybeate springs, it has been found in larger quantity.

But in Indian waters, silica is by no means an insignificant constituent, and it is probable that few waters are

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[*] Reprinted from the *Madras Monthly Journal of Medical Science* for December, 1871.

[*] The centigramme is a more convenient unit than the grm. for water analysis; 10 centigrammes (0·1000 grm.) per litre are equal to 7 grs. per gallon.

free from it. In the analyses recorded in the Bengal reports, the silica given must always be rather under the real quantity, as it is apparently estimated in the insoluble part of the residue of evaporation, or even in the deposit produced by boiling; yet it is always stated to be present, and the quantity given is often as much as 8 or 10 centigrms. per litre; in one case as much as 16 centigrms. is recorded. In Bangalore waters I have met with as much as 8 centigrms. per litre.

Alumina is also rarely absent from Indian waters; I have frequently found as much as 2 centigrms. per litre.

Now silica (silicon dioxide or silicic anhydride) is all but completely insoluble in water, whilst its hydrate, silicic acid, is soluble to a considerable extent though unstable, and some of the metallic silicates are also soluble and, moreover, stable. If we found only traces of silica in water its condition might be doubtful, but when we find that quantities of 8 centigrms. per litre, and upwards are by no means uncommon, and that such waters are capable of concentration to any extent without the solubility of the silicon compound being much impaired, then it is evident that the silicon cannot be present in the form of the insoluble oxide which we extract during analysis. Neither is it in the form of free silicic acid, as this substance, though of considerable solubility, is unstable and a *colloid*, whilst the silicon compound present in water is but little affected in solubility by repeated evaporation and ignition, and passes perfectly through a dialysing medium. It must therefore be as a soluble silicate that the silica we find was present in water. In order to determine the condition and properties of this silicate, I made the following experiments on a water of very constant composition, that of the Dhobies' wells at Bangalore, containing, as a mean of analyses at various times, the following mineral constituents:—

	Centigrms. per litre.
Sodium	4·37
Potassium	0·42
Magnesium .. 0·56 to 0·77. mean	0·66
Calcium	3·17
Aluminium (traces of iron) ..	0·35
Chlorine	3·75
Sulphuric acid, SO_4,..	0·72
Nitric acid, NO_3, ...	0·01 (maximum)
Phosphoric acid, PO_4..	0·11
Silicic acid, SiO_3	4·34 (SiO_2 3·43)
Carbonic acid, CO_3, and loss ..	7·10
Mean residue of evaporation ..	25·00*

These constituents were divided into "soluble" and "insoluble" in four different ways, and in each case the total solids, the silicic acid, the aluminium, the calcium, and the magnesium were determined separately in the deposit and in the solution. The results are given in the following table:—

	A. Evap. to ½ in an open vessel.		B. Evap. to 1-15th in a closed vessel.		C. Evap. to 1-30th in a open vessel.		D. Evap. to dryness and ignition in an open vessel.	
(Centigrms. per litre). ..	Deposit.	Solution.	Deposit.	Solution.	Deposit.	Solution,	Deposit.	Solution.
Total solids	13·71	10·29	11·46	14·77	10·43	15·14	13·57	12·00
Percentage	57	43	43	57	40	60	53	47
Silicic acid	0·10	4·33	0·06	4·26	2·08	2·17	3·89	036
Percentage	2	98	1	99	49	51	91	9
Aluminium	0·11	0·26	?	0·01	Not determined.		0·34	none
Percentage	30	70	97?	3?			100	0
Magnesium	0·04	0·72	0·55	0·01	0·67	0·10	0·76	0·01
Percentage	5	95	98	2	87	13	99	1
Calcium	2·86	0·37	3·00	0·07	2·97	0·20	3·03	0·04
Percentage	88	12	98	2	94	6	99	1

The evaporation marked B was by far the most interesting experiment, as the influence of atmospheric carbonic acid was excluded; the deposit and the concentrated water were made the subject of further experiment.

The deposit during evaporation consists of two parts; one firmly adhering to the sides of the vessel, and consisting principally of calcium carbonate; the other of much looser consistence and readily detached. This latter portion, as obtained in evaporation B, showed the following composition in 100 parts—

Magnesium	3·78
Calcium	15·23
Aluminium	8·55 (with some iron).
Phosphoric acid	0·98
Silicic acid	46·86
Carbonic acid and loss ..	24·28
	100·00

These constituents may be combined as follows:—

Aluminium phosphate	1·26
Aluminium silicate	42·50
Magnesium silicate	16·62
Calcium carbonate	38·07
	98·45

This deposit is evidently formed subsequently to the hard deposit of calcium carbonate, and consists principally of the less soluble silcates deposited gradually during evaporation.

The concentrated water obtained in evaporation B was found to contain 228·71 centigrms. of mineral solids per litre, and only retained a small amount of earthy salts, giving a hardness of 1·43° (=1·43 centigrms. of calcium carbonate per litre).

Four ounces ($\frac{1}{40}$ gallon) of it were evaporated to dryness; towards the end of the evaporation, a tough flexible pellicle formed on the surface, but there was no appearance of gelatinous silicic acid. The residue, after being ignited in order to expel the notable amount of organic matter,* weighed 4·00 grains (=228·71 centigrms. per litre). Treated with boiling distilled water it dissolved, with the exception of 0·26 grain; this insoluble residue was found to contain—

Silica	0·240 grain
Calcium	0·012
Magnesium	traces
Aluminium	0·004

This evaporation and re-solution of the residue was repeated three times, and each time there was left a small insoluble residue of the same character as the first, the quantity of calcium, &c., diminishing, however, to mere traces. The quantities of silica obtained were—

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* For the formula of the combinations of these constituents see at the end of this paper.

* Boiling a water does not rid it of organic matters: it is probable that suspended organic matters only are carried down in the calcareous precipitate.

	Grs.	Centigrms. per litre.
First evaporation	0·240	13·71
Second "	0·180	10·28
Third "	0·170	9·71
Fourth "	0·085	4·85
Remaining in solution after four evaporations	0·240	13·71
Total silica present.. ..	0·915	52·26

It is evident that the 38·57 centigrms. per litre, equal to 74 per cent of the whole amount, remaining in a soluble condition after the first evaporation and ignition, must have been in the condition of an alkaline silicate, and that its gradual elimination by repeated evaporations and ignitions was owing to the decomposing effect of atmospheric carbonic acid.

Four ounces ($\frac{1}{40}$ gallon) of this concentrated water were dialysed for two days, the distilled water being changed twice; evaporation gave a residue of 0·070 grain, of which 0·025 grain was silica; 0·890 grain of silica had passed therefore through the dialyser, leaving only 2 per cent. This confirms the evidence that a soluble silicate, and not free silicic acid, was present in the concentrated water.

On comparing the results of these evaporations of the water concentrated in B with the evaporation D, it will be observed that in the former case no less than 74 per cent of the silicic acid remained soluble after ignition of the evaporated residue, while in evaporation D only 9 per cent remained soluble after the same treatment. The reason of this is that in the latter experiment the alkaline silicate was evaporated to dryness, and ignited in the presence of a deposit of calcium carbonate; consequently, insoluble silicate of lime was formed, leaving carbonate of soda in the soluble portion; while the water concentrated in evaporation B was evaporated without access of atmospheric carbonic acid,* and the evaporation was completed and the ignition performed after removal from the deposit of calcium carbonate. The decomposing effect of atmospheric carbonic acid, and of the calcareous deposit, is shown also in evaporation C; this having been done with access of air, in presence of the calcareous deposit, and also being pushed further towards dryness, we find that only 51 per cent of silicic acid remained in solution, instead of 99 per cent as in evaporation B.

When the concentrated water of evaporation B was evaporated to dryness after addition of some artificial calcium carbonate, the amount of silicic acid recovered by treatment with boiling distilled water was only 45 per cent instead of 74 per cent, this addition assimilating the evaporation in a great measure to that made in experiment D under the influence of the natural calcareous deposit. We find, then, that the effect on the silicic acid of evaporation in presence of calcium carbonate may be stated thus:—

	Silicic acid become insoluble, per cent.	Silicic acid remaining soluble, per cent.
Water concentrated to $\frac{1}{15}$, evaporated and ignited after separation of the calcareous deposit	26	74
The same, but evaporated and ignited in presence of artificial calcium carbonate	55	45
Water evaporated and ignited without separation of the calcareous deposit	91	9

In all these cases, both the original water and the solution of the evaporated residue had an alkaline reaction, the original water containing earthy carbonate and both earthy and alkaline silicates, and the solution of the evaporated residue containing alkaline silicate and carbonate.

The following conclusions may be drawn from these experiments:—

1st. The silica found in the analysis of waters was present as silicic acid combined with basic metals, generally sodium, magnesium, and aluminium.

2nd. These three silicates, alkaline, earthy and aluminous, differ in solubility; the aluminium silicate is the least soluble, and begins to be deposited when evaporation has concentrated the water by a quarter or a half; magnesium silicate is deposited only towards the end of the evaporation; sodium silicate is of perfect solubility, and remains in solution to the last.

3rd. The sodium silicate is, however, liable to decomposition from two causes; atmospheric carbonic acid eliminates the silicic acid slowly during evaporation, and the deposit of calcium carbonate which takes place in nearly every water enters with it into a mutual decomposition, having for result the formation of insoluble calcium silicate and of soluble carbonate of soda.

4th. The evaporation of a calcareous water may be divided into the following stages:—

First.—Expulsion of carbonic acid gas, causing the precipitation of the insoluble substances which it held up—calcium carbonate, magnesium carbonate,* aluminium or ferric phosphate, ferrous carbonate.

Secondly.—Gradual deposit of slightly soluble substances as the water becomes supersaturated with them; aluminium silicate, magnesium silicate, calcium sulphate, are thus successively deposited.

Thirdly.—Reaction of the precipitated calcium carbonate on the sodium silicate in solution, the silicic acid becoming replaced by carbonic acid.

Fourthly.—Final evaporation to dryness, causing the crystallisation of alkaline chlorides or sulphates, and of any alkaline carbonates that may exist naturally or may have just been formed; deposit of any alkaline silicate that has escaped decomposition, and of any soluble earthy salts.

Fifthly.—Sodium carbonate may be present naturally in a water, usually as bicarbonate, before evaporation. In a concentrated water it must of course be as carbonate; the loss of its second atom of carbonic acid is often testified by the soapy feel and smell which the water acquires. Its presence is incompatible with that of any earthy salts but carbonates; for instance, calcium sulphate cannot be present, because calcium carbonate and sodium sulphate will inevitably be formed in consequence of the actual or potential insolubility of the former, and the much greater affinity of the strong acid radicals for the alkaline metals than for the earthy metals. Conversely, if a water which has been well boiled, or the solution obtained by washing the residue of evaporation of a water, shows a greater hardness than that ascribable to the small quantity of earthy carbonates or silicates still in solution—no alkaline carbonate can be present. Water will retain as much as 2 or 3 centigrms. of calcium carbonate per litre after boiling, and the magnesium carbonate or silicate may amount to as much more, so that a water may have a "permanent hardness" of six degrees or perhaps more, without containing any earthy sulphates, nitrates, or chlorides.†

But if instead of simply boiling the water it be evaporated to dryness and the residue treated with hot distilled water sufficient to dissolve the soluble earthy salts, the sources of error are eliminated, and a hardness

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* More properly carbonic anhydride.

* Magnesium carbonate is somewhat soluble; when in small quantity it remains in solution, often becoming changed into silicate at the end of the evaporation.

† However worthless be the results of the soap-test in unpractised hands, there is no doubt that if used with ordinary skill, it affords rapid and fairly accurate information as to the amount of earthy metals present in dilute solutions. The best graduation is that of 1°=1 centigrm. of calcium carbonate per litre.

of more than 1 degree (calculated on the original volume of the water) shows with certainty that earthy sulphates, chlorides, or nitrates are present. Waters absolutely free from those salts do not show more than one or two-tenths of a degree of permanent hardness if it be determined in this way.

From this incompatibility of sodium carbonate with earthy sulphates, &c., we may deduce that sodium silicate is also incompatible with them, and it may be taken as a rule that waters containing earthy sulphates, nitrates, or chlorides, contain no sodium carbonate or silicate, and that the residue of evaporation (this being necessary in order to eliminate earthy carbonates) will show but feeble alkaline reaction. In these waters the silicic acid must be combined with aluminium or magnesium (or calcium ?). There can be no mistake on this point in working out the formula of a water from its analysis, as waters of permanent hardness will always contain a quantity of sulphuric acid, nitric acid or chlorine, much in excess atomically of the amount of alkaline metals present.

Sixthly.—When the residue of evaporation of a water is divided, by washing, into soluble and insoluble salts, the result is by no means constant. We have seen that 9 per cent of the silicic acid may still remain soluble; a portion of the insoluble silicic acid may be present as silica, having been eliminated by atmospheric carbonic acid, whilst another portion is in the form of calcium silicate formed by double decomposition. Practically, though the amount of residual mineral solid is very fairly constant in a water exempt from earthy chlorides or nitrates, the division of these solids into "soluble" and "insoluble" by treatment with water does not afford very constant results. Two determinations, made under the same circumstances as far as possible, will differ by as much as 1 or 2 centigrms. per litre. This separation of the residual mineral solids into "soluble" and "insoluble," however useful in purely hygienic examinations, and as a check in working out the formula of a water, cannot be taken as the basis of an analysis.

Seventhly.—Until some practical method of estimating carbonic acid can be made available for ordinary use, there will always be some difficulty in working out with certainty the formula of a water. The difficulty in working it out with the carbonic acid estimated differentially, would be very great if the soluble combinations of silicic acid were as complicated as its natural insoluble combinations. Fortunately they are not, and I believe that when the subject has been fully investigated, it will be found that the natural soluble silicates are simple in composition.

Eighthly.—From the above experiments it is, I think, evident that the terms "silica" and "alumina" should be dropped in statements of analyses, and that "silicic acid" and "aluminium" should be used as in the case of the other acid and basic radicals. The question then arises, how is silicic acid to be represented, soluble silicic acid being H_4SiO_4, whilst silicon dioxide is SiO_2? The annexed table of the oxygen derivatives of silicon, with those of the other elements of the group carbon, boron, and silicon, will, I hope, explain this point satisfactorily. It will be seen that, like the ortho-borates, the ortho-silicates are dehydrated by heat, and ortho-silicic acid, H_4SiO_4, becomes H_2SiO_3, meta-silicic acid; the acid radical should therefore be represented in analysis by SiO_3. Having worked out the formula of a number of analyses both of my own and amongst those published by European chemists, I find that the silicates found in water are not usually of other than simple composition. I would direct the attention of analysts to the subject; but as far as I can see at present, I believe that the silicates we find in water may, when dehydrated, be represented in the same way as the salts of any other acid derived from a dyad radical, thus:—

$$Na_2SiO_3—MgSiO_3—Al_{23}SiO_3$$

in the case of a monovalent, a divalent, and a trivalent metal respectively.

It is on the basis of this assumption that I have arranged the formula of the water used in the foregoing experiments and the radical constituents of which have been detailed. It will be seen that the total agrees very fairly with the quantity of mineral residue left on evaporation; the difference is owing partly to the loss which must inevitably occur in the analysis of such dilute solutions, and partly to the absorption of atmospheric carbonic acid by the alkaline silicates during the process of evaporation. But, *per contra*, in an analysis calculated as usual with all the silicates decomposed into silica and carbonates, there will be generally a considerable surplus on the total of the constituents calculated over the mineral residue obtained by evaporation. The quantities found in this analysis yield the following formula:—

	Centigrms. per litre.
Sodium chloride	6·17
Sodium sulphate	0·26
Potassium sulphate	0·96
Sodium silicate	4·93
Aluminium phosphate	0·14
Aluminium silicate	1·64
Magnesium carbonate	2·31
Calcium carbonate	7·92
Total	24·38

The total shows a loss of 0·67 centigrm. on the mean total residue (25·00 centigrms.) found by evaporation, but if the formula were calculated in the usual manner, with silica, alumina, and phosphoric acid uncombined, and carbonic acid gratuitously bestowed on the basic radicals not provided with chlorine and sulphuric acid, the total would show no longer a loss, but a gain of 1 centigrm. on the total residue found by evaporation. It was this gain against all probability that first awakened my suspicions of the correctness of the usual calculations.

Comparative Table of the Oxygen Derivatives of the Natural Group Carbon, Silicon, Boron.

Carbonic anhydride, CO_2. (Carbon dioxide).	Silicic anhydride, SiO_2. (Silicon dioxide).	Boric anhydride, B_2O_3. The following modifications of boric acid may be considered as successive combinations of boric anhydride (2 atoms), with 1, 2, 3, and 6 atoms of water.
	Pyrosilicic acids. Pyrosilicates of the types $H_2Si_2O_5$ and $H_4Si_3O_8$ may be considered as existing in certain felspars.	Pyroboric acid, $H_2B_4O_7$. Fused borax $Na_2B_4O_7$ may be considered as a salt of this hypothetical acid.
Carbonic acid, H_2CO_3.	Metasilicic acid, H_2SiO_3. May be considered as existing in dry sodium silicate, Na_2SiO_3.	Metaboric acid, HBO_2. Neutral borax is $NaBO_2$.
		Tetraboric acid, $H_6B_4O_9$. (Hypothetical).
	Orthosilicic acid, H_4SiO_4. (Soluble silicic acid). Sodium silicate in solution may be considered as $H_2Na_2SiO_4$.	Orthoboric acid, H_3BO_3. Ordinary borax may be considered as $H5Na2BO_3$.

TESTING INDIGO.

By J. M. MERRICK, S.B.

In Sutton's "Systematic Handbook of Volumetric Analysis (ed. 1863, p. 179), a paragraph occurs which has always seemed to me calculated to mislead beginners, viz., "Schlumberger's method consists in adding the indigo solution . . . . to a measured quantity of solution of chloride of lime, the strength of which has just previously been determined by a solution of pure indigo-blue; *but as this is a most expensive and rare material, and must be used for almost every analysis, the process will not be further described.*" The statement in italics is incorrect. Pure indigo-blue, to be sure, is expensive—is advertised in French catalogues at 1 fr. 50 c. per grm.; but it is not difficult to prepare, and need not be used for every analysis.

An excellent plan is to prepare some indigo-blue of perfect purity, dry it for some hours at 100° C., and then determine accurately the per cent of blue in a choice sample of Bengal blue; which afterwards can be kept as a standard, and by a simple process, the percentage value of any other indigo obtained.

I have always found a weak solution of potassic permanganate preferable to a solution of chloride of lime for testing indigo and cochineal. It does not precipitate the colouring or other matters from the solution, and gives, I think, sharper readings.—*American Chemist.*

SPONTANEOUS COMBUSTION.

In March last, a well-known Detroit druggist, assisted by two seriously inclined and science-loving gentlemen, resolved to make a number of experiments to test the worth of the talk about spontaneous combustion, and their experiments are well worth the attention of every reader.

They first took a piece of cotton cloth, which had once formed part of a sheet, and which had been used until quite threadbare, and smeared it with boiled linseed oil. An old chest was placed in the loft of a store-room back of the drug store, a piece of zinc over it, another piece under it, and then the chest filled with paper and rags, and this particular piece of cloth placed in the centre. Although the room was not a light one, and the weather cold, in eight days there was such a smell of fire about the trunk, and the chances were so good for a conflagration within it, that the contents were emptied.

An examination showed that the fibre of the oil-cloth had untwisted and shrivelled up, and that the rag looked as if it had been held too near a hot blaze. In April, when the rays of the sun were stronger, a pair of painter's overalls, literally covered with paint and oil, were rolled up, a handful of pine shavings placed inside, and these were crowded in next to the roof boards of the loft. The experiment was not a week old when, during one warm afternoon, a smell of smoke alarmed a workman in the next room, and he found the overalls burning, and so tinder-like was the cloth that it had to be crowded into a pail of water to prevent total destruction.

During the hot weather of August, a handful of old cotton rags, in which two matches were placed, but which were not smeared with oil or other matter, were shut up in a tin box, and hung up in the loft, a rear window allowing the afternoon sun to shine directly on the box for several hours. Toward the close of the fourth day the druggist took down the box to see how the experiment was progressing, and found the contents to consist of nothing but a puff of black cinders, which flew all over him as the lid was lifted. Having a vacant corner in his brick wood-house at home, the druggist took the trunk up there, where there was no danger of burning a building. He filled the trunk with the contents of the paper rag-bag, and then smeared one with benzine and threw it in last of all. The trunk was shut tight, everything cleared away from its vicinity, and he commenced watching. One day the family came home to find a few ashes marking the place where the trunk stood, while the bricks above and around were badly stained with smoke.—*Scientific Press.*

ON BENDING GLASS TUBES FOR FITTING APPARATUS.

By J. LAWRENCE SMITH.

It is well known that it requires some tact to bend a tube with an even curve and without collapsing its sides, and many chemists never do succeed in bending them skilfully. Although having no particular skill in this matter, I never fail to bend them perfectly satisfactorily, by using a flame different from the one usually employed; the flame is one given by the Bunsen burner described in my article on alkali determination in silicates. (See Chemical News, vol. xxiii., p. 235). The burner is very commonly used now in all laboratories, where the extremity of the burner is flattened out so as to give a short and thin but broad flame, something like the flame of an ordinary gas-burner. The tube is placed in this flame and turned round and round, until a good heat is given to the tube; it is then withdrawn from the flame and bent, when it does so with a perfect curve and no collapse of the sides of the tube. Of course this is only intended for the smaller tubes, but a tube of 1 centimetre and more can be thus bent very readily.—*American Chemist.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 4th, 1872.

Dr. Frankland, F.R.S., President, in the Chair.

As soon as the minutes of the previous meetings had been read, the following gentlemen were formally admitted Fellows of the Society:—Messrs. E. N. Butt, John Ruffle, Thomas Greenish, and Edward Smith.

The names of candidates read for the first time were those of Messrs. Richard Anderson and George Cordwent.

For the third time—Messrs. William Frederick Donkin, B.A. Charles D. Hunter, Reynold Le Neve Foster, Alexander Noble, W. Little, and William Henry Walbourne, who were afterwards balloted for and declared duly elected.

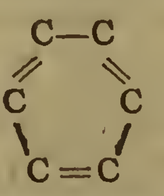
The President then called on Dr. Schorlemmer, F.R.S., to deliver his lecture on "*The Chemistry of the Hydrocarbons.*" After briefly sketching the history of the division of chemical science into the two branches of inorganic and organic, the lecturer mentioned that, although Gmelin had previously called attention to the presence of carbon in all organic compounds, Kekulé was the first who distinctly advocated the view that organic chemistry should be considered as the chemistry of the carbon compounds, and in this he has since been very generally followed. The hydrocarbons are not only the most simple of the carbon compounds, but most important from a theoretical point of view, as all other carbon compounds may be regarded as derivatives of them, that is, as being formed by a replacement of their hydrogen by other elements or groups of elements, so that we may define organic chemistry as the chemistry of the hydrocarbons and their derivatives. The first hydrocarbons considered were the paraffins, which have the general formula C_nH_{2n+2}, and in which the tetrad-carbon atoms are linked together, the free combining capacities of such a group being saturated by hydrogen, so that their most characteristic property is, that they are not capable of uniting with other bodies. The lecturer then noticed the two assumptions which had been made to account for the isomerism occurring in this group, namely, that founded on the supposed difference in function between the four combining affinities of the carbon atom, and the generally received one of the different grouping of the carbon atoms. The paraffins may be divided into four groups. (1) The normal paraffins, in which each carbon atom is united directly to at most two others. (2) Those in which it is directly united to three others, or which contain the group isopropyl. (3) Those containing the isopropyl group twice. (4) Those in which one carbon atom is combined directly with four others.

By subtracting two atoms of hydrogen from the paraffins we obtain the second group of hydrocarbons, called by Guthrie the olefines, which, although they closely resemble the paraffins in their physical properties, are readily distinguished from them by the energy with which they combine with the haloid elements. In respect to their constitution they may be regarded either—(1) as containing carbon atoms with free combining units; (2) as having one of the carbon atoms a dyad instead of a tetrad; or (3) as having one carbon atom linked to the other by two combining units. The great bulk of evidence is in favour of the latter view, namely, that they are really saturated compounds containing two carbon-atoms linked together by two combining units of each,—ethylene, $H_2C=CH_2$. The polyolenes were then discussed with especial reference to the constitution of diamylene, the only member of this group which has been carefully studied.

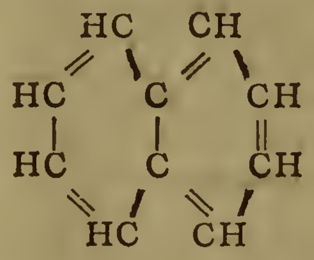
The hydrocarbons of the acetylene series are formed by abstracting 2 atoms of hydrogen from the olefines; the general method of effecting this being to remove two molecules of hydrobromic acid from the corresponding olefine dibromide. In acetylene, C_2H_2, the first member of this series, the two carbon atoms are linked together by three combining units of each atom $HC\equiv CH$, and its homologues may be regarded as derived from it by substitution of a monad alcohol radical for 1 atom of hydrogen.

The hydrocarbons of the series C_nH_{n2-4}, of which only two have as yet been prepared artificially, includes the very large number of hydrocarbons called terpenes found in plants. These possess the property of being easily converted into new isomeric modifications, which may again be changed into new isomerides, but all yield at the end one and the same product, called *terebene*, whose most characteristic property is that it forms a hemi-hydrochloride, $(C_{10}H_{16})_2HCl$. On oxidising terpenes terephthalic acid is always found amongst the products, and as this acid is also formed in a similar manner from certain aromatic hydrocarbons, it is highly probable that these two series are nearly related.

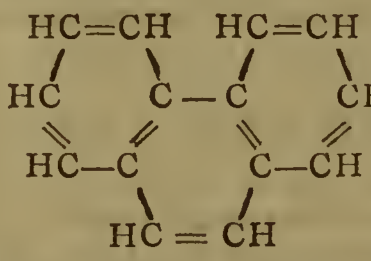
Aromatic Hydrocarbons.—In this group the following points may be noted:—(1) That they all contain a common nucleus consisting of six atoms of carbon. (2) These six atoms are linked together by one and two combining units alternately, thus leaving six combining units non-saturated—



(3) All aromatic compounds are formed by saturating these free units with other elements or radicals. (4) The differences observed in certain groups of isomeric aromatic compounds are caused by the different relative position of certain elements or radicals in the nucleus. The speaker then gave an account of the isomerism in this series on Kekulé's well-known hypothesis, and explained the different effect of oxidising agents on the benzenes containing one, two, or more hydrogen atoms replaced by alcohol radicals, which he illustrated by the oxidation of the isomerides, ethyl benzene, α cymene, and β cymene. Oppenheim regards oil of turpentine as a hydrogen addition-product of the hydrocarbon, $C_{10}H_{14}$; and other aromatic hydrocarbons exist having less hydrogen than that required by the formula C_nH_{2n-6}. Amongst the products of the destructive distillation of coal, a hydrocarbon, $C_{10}H_8$, *naphthaline*, always occurs, which bears such a close chemical resemblance to benzene that it must have a constitution very similar to it, and which Erlenmeyer considers to be—



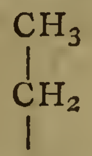
This view is substantiated by the action of oxidising agents on the pentachlornaphthaline produced by the action of phosphorus-pentachloride on dichlornaphthylquinone. Anthracene, $C_{14}H_{10}$, frequently occurs, accompanying naphthaline in coal-tar, and its probable constitution has been ascertained by Graebe and Liebermann, in their researches on alizarine, to be—



The author also mentioned pyrene, $C_{16}H_{10}$, chrysene, $C_{18}H_{12}$, and idrialine, $C_{22}H_{14}$, and concluded by observing that no branch of our science better illustrated the progress made in chemistry during the last thirty years than that of the hydrocarbons; and this he considered to be due mainly to the atomic theory, which had been gradually developed and expanded to its present state by the efforts of various eminent chemists, amongst whom he might mention Laurent and Gerhardt, Williamson, Odling, and Kekulé.

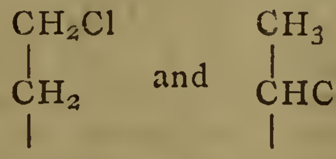
The President said that, in the interesting lecture they had just heard, Dr. Schorlemmer had amply demonstrated how important this department of modern chemistry was, and how many problems could be illustrated and explained by studying the compounds of carbon and hydrogen; but he would remark that the line of demarcation drawn by including all carbon compounds, or, what amounts to the same thing, all hydrocarbons and their derivatives under the head of organic chemistry, has its defects, as in teaching he must plead for the advantage derived from retaining such compounds as carbonic acid and carbonic oxide amongst inorganic compounds; this could readily be done by a simple modification of the definition, making it to include all compounds in which the carbon is united directly either with carbon, hydrogen, or nitrogen; this would exclude carbonic acid and carbonic oxide, and include all that was desirable. With regard to the observation which the lecturer had made with reference to the non-existence of a difference between the several bonds of the carbon atoms, he must say that the evidence of such a difference was very slight; still there were a few compounds described which appear to give some foundation for this view—amongst these he might mention the two methylic bromides, and also the question as to whether an isomeric ethylic chloride was not formed along with the normal ethylic chloride by the action of chlorine on ethylic hydride. Dr. Schorlemmer had conclusively shown that the normal chloride was produced in this reaction; but he believed he had not shown that nothing else was produced. Again, in the wonderful chain of carbon atoms suggested by Kekulé as the benzene nucleus, it occurred to him that it would be possible to have more than three isomeric dimethylbenzenes; for instance, in the case where the methyls were united to two adjacent carbon atoms in the ring which were themselves united by one bond, must be different from a similar compound where the carbon atoms were united by two bonds: no doubt the difference would be minute, and therefore very likely to be overlooked.

Dr. Wright said there were one or two points he would like to ask about, one of which was, that as Dr. Schorlemmer had shown that when a normal paraffin—



$$\begin{array}{c} CH_3 \\ | \\ CH_2 \\ | \end{array}$$

is acted upon by chlorine only two monochlorides are formed, viz.,—



$$\begin{array}{c} CH_2Cl \\ | \\ CH_2 \\ | \end{array} \quad \text{and} \quad \begin{array}{c} CH_3 \\ | \\ CHCl \\ | \end{array}$$

none of the links except the two terminal ones being attacked, could he give any theoretical explanation of this? With respect to the olefines, and the formation of C_2H_4 by the action of metals on C_2H_5I, he might say that, in an experiment he had made with a mixture of $C_2H_4Br_2$ and $2(C_2H_5I)$, C_2H_6 and C_2H_4 were evolved, the latter being proved to be the normal olefine, by its yielding normal ethylene bromide when passed into bromine. As the names ethylene and ethylidene are given to the two hydrocarbons, the first of which is known in the free state, and the latter only in combination, he would suggest the term olefidene as a generic term corresponding with olefine for the latter series. With respect to the hydrocarbons, $C_{10}H_{16}$, yielding terephthalic acid by oxidation, although myristicene from nutmegs yields about 15 per cent of that acid, he had met with at least one instance, viz., the essential oil from orange peel, from which he could not obtain any trace of terephthalic or isoterephthalic acids.

Dr. Muller said that from oil of turpentine the yield was very small, 10 or 12 lbs. giving only 2 or 3 ounces of acid; in fact, from his experiments, he was inclined to believe, although he had no absolute proof of it, that the terephthalic acid was derived from traces of cymene present in the essential oils.

Dr. Armstrong remarked, with regard to the constitutional formula for anthracene given by Graebe, and the splitting up of anthraquinone, under the influence of oxidising agents, into benzoic acid, this could be equally well explained from the fundamental property of the C_6H_5 group of resisting oxidation; in the case of benzene itself, one portion was oxidised to formic acid, carbonic acid, and water, and another formed benzoic acid.

Dr. Schorlemmer replied that, with respect to the action of chlorine on ethylic hydride, the products were ethylic chloride and chlorinated ethylic chloride, but a considerable portion of the gas was unacted upon and carries off with it much of the ethylic chloride. As to chlorine attacking only the two end links in the carbon chain of the paraffins, thus forming only two monochlorides, he had no theoretical explanation to offer: he simply knew it as a fact.

The President said he had been about to ask the Fellows for a vote of thanks by acclamation to Dr. Schorlemmer for his interesting lecture, but they had rendered that unnecessary. He would now ask the Secretary to read the list of communications for the next meeting.

The meeting then adjourned until Thursday, April 18th, when the following papers will be read:—"On the Action of Phosphorus Pentasulphide on Tetrachloride of Carbon," "On the Degree of Solubility of Silver Chloride in Strong Nitric Acid," and "On a Remarkable Salt Deposited from the Mother-Liquors obtained in the Manufacture of Soda," by T. E. Thorpe; "On a Double Sulphide of Gold and Silver," and "On the Solvent Action of Various Saline Solutions upon Lead," by M. M. P. Muir; "On the Composition of Ceylon Jargons," by M. H. Cochrane; "On the Magnetic Sand of Mount Etna," by J. B. Hannay; and "On a Compound of Sodium and Glycerine," by E. A. Letts.

CORRESPONDENCE.

JAMES BARWICK JACKSON.

To the Editor of the Chemical News.

Sir,—Many of your readers will learn with deep regret the sudden disappearance from among us of a well-known and useful man, whose familar face and obliging manners will be long remembered by them. I allude to James Barwick Jackson, of the firm of Messrs. Jackson and Townson, manufacturers of chemical apparatus and reagents, who has been cut off from his laborious career by a short but severe attack of inflammation of the lungs and at a comparatively early age. Many of your readers will, like myself, feel his loss keenly, and join with me in paying a slight tribute to his memory by desiring to record his name and the sympathy felt for his family and his partner, in the columns of your widely circulating journal.

Jackson's life has been one of much value to many of us, and especially so to English analytical chemists, by the skill and care with which he has supplied us for so many years with new and elaborate apparatus, with chemical novelties of every description, and with the numerous chemical products constantly required in the laboratory. When we add to this his extensive practical knowledge, his polite attention, his constant anxiety to please, and, above all, his most excellent and upright character, it will not be difficult, even for those who did not know him personally, to appreciate his services, and to realise the loss we have experienced by his death. Fortunately, he has left behind a worthy son, capable of continuing in his father's steps, and whose love of chemistry has been increased by careful study at one of our Universities.—I am, &c.,

T. L. Phipson, Ph.D., F.C.S.,
Member of the Chemical Society of Paris.

London, April 6, 1872.

MISCELLANEOUS.

Adulteration of Whisky.—At the last meeting of the Chemico-Agricultural Society at Belfast, under the presidency of Dr. Knox, late Poor Law Inspector, the subject of whisky adulteration was brought under consideration by Dr. Hodges, who exhibited a specimen of that liquid brought to him by two men who had been physically incapacitated by drinking a small portion of it in a public-house. He found, on analysis, that it contained a large amount of naphtha. He had also discovered that ingredients of even a more deleterious character were used in the process of adulteration,—mixtures containing sulphate of copper (blue stone), cayenne pepper, sulphuric acid (vitriol), and a little spirits of wine. One specimen submitted to Dr. Hodges by a number of provision cutters and curers, was composed of naphtha and a slight colouring of whisky. The men who had imbibed a small quantity of it were affected with serious symptoms; and this, said Dr. Hodges, was a fair specimen of the drink sold in low-class public-houses. The trade in this noxious compound is carried on with impunity, no local authority in Belfast or in the Province of Ulster caring to exercise the powers with which the legislature has invested them for the suppression of the traffic.

A Measure for the Intensity of Light.—Dr. Vogel proposes *nitroprussidiron* as a suitable salt for determining quantitatively the intensity of light. For the preparation of this reagent, dissolve chemically pure oxide of iron, best obtained from the oxalate, in hydrochloric acid, and evaporate nearly to dryness to expel the excess of acid; and after filtering, add an aqueous solution of nitroprussidnatrium in proportion of three of the iron to two of the latter. There is usually a slight precipitate produced by this mixture, which can be collected on a filter; but this operation must be performed in a dark room. We have now a liquid excessively sensitive to the action of sunlight. By exposing a small quantity of a known specific gravity to the action of light, a precipitate of prussian-blue will instantly begin to fall; and, on redetermining the sp. gr. in the dark chamber, its decrease will be found to be proportional to the precipitate; and we have thus the data for measuring the intensity of light. It was found by Dr. Vogel that the liquid, exposed for forty-eight hours before a kerosene lamp, was not in the least affected, but a piece of magnesium wire, when burned, immediately produced a precipitate. By employing a long instrument graduated in millimetres, it would appear to be possible to measure the intensity of the light by the number of millimetres occupied by the precipitate. The invention has an important bearing upon photography.—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, March 11, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Proportion of Ozone Contained in Country Air, and on the Origin of that Ozone.—A. Houzeau.—In this essay the author discusses the means of at least approximatively estimating the proportion of ozone met with in country air at a height of 2 metres above the surface of the soil. Taking the specific gravity of ozone, according to Soret, at 1·658, the author deduces from his experiments that the country air (but where is not stated) contains a maximum of 1-450,000th of its weight, or 1-700,000th of its bulk, of ozone. As regards the origin of ozone, the author holds it to be due to atmospheric electricity constantly acting in the manner of a huge-sized condenser between the soil and the clouds.

Density of Hydrochloric Acid.—M. Kolb.—The contents of this essay, elucidated by a series of tabulated forms exhibiting the percentage composition and specific gravity, at 0° and 15°, of hydrochloric acid of from 0 to 25·2 areometrical degrees, and also observations on the tables of Davy and Dr. Ure bearing on the percentage composition and specific gravity and areometrical degrees corresponding therewith, are not, for the obvious reasons here alluded to, suited to any further detailed quotation, notwithstanding their high scientific as well as practical value.

This number also contains a very large number of valuable papers relating to meteorology, astronomy, natural philosophy, and zoology.

March 18, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Phenomenon of Crystallisation of a very Concentrated Saline Solution.—Professor Chevreul.—The author describes at great length some phenomena observed by him while inspecting certain saline solutions left standing for spontaneous evaporation for some thirty years, but, notwithstanding the scientific value of these observations, we cannot enter here into any details on this subject, owing to the great length of this memoir.

Formation of Chloral.—A. Wurtz and G. Vogt.—In the introduction to this very lengthy essay, the authors discuss the mode of action of chlorine upon aldehyde, whereby chloride of acetyl—

$$CH_3-COCl,$$

is formed. When, however, the aldehyde is mixed with alcohol, and then submitted to the action of chlorine and some iodine, there is formed a tetrachlorated ether, which is readily converted into chloral. When pure, this ether is a colourless liquid, boiling at between 183° and 188°; sp. gr. at 0° = 1·426; it is identical with the compound $C_4H_6Cl_4O$, described by Malaguti as resulting from the direct action of chlorine upon ether, and is also identical with the body recently obtained by Dr. Henry while causing perchloride of phosphorus to act upon the alcoholate of chloral. The ether alluded to, being heated in a sealed tube along with water to 100°, is dissociated, forming alcohol, hydrochloric acid, and chloral, according to the following formula:—

$$\underbrace{CCl_3-CH\left\{\begin{matrix}OC_2H_5\\Cl\end{matrix}\right\}}_{\text{Tetrachlorated ether.}}+H_2O=HCl+C_2H_5.OH+\underbrace{CCl_3-COH.}_{\text{Chloral.}}$$

When the ether just named is heated along with alcohol at 100° for some days, the result is that it is converted into hydrochloric acid and trichlorated acetal—

$$\underbrace{CCl_3-CH\left\{\begin{matrix}OC_2H_5\\Cl\end{matrix}\right\}}_{\text{Tetrachlorated ether.}}+C_2H_5.OH=ClH+\underbrace{CCl_3-CH\left\{\begin{matrix}OC_2H_5\\OC_2H_5\end{matrix}\right.}_{\text{Trichlorated acetal.}}$$

Again, by distilling the tetrachlorated ether with sulphuric acid, there is formed chloral, in addition to chloride of ethyl. A very large portion of this exhaustive essay is entirely devoted to the detailed description of a series of experiments mainly made with the view to prove that, by a circuitous process, chloral may be obtained as a derivative of aldehyde.

Researches on the Preservation of Wines.—M. de Vergnette-Lamotte.—The contents of this memoir and of that following are only valuable to wine-growing countries:—

Observations on the Preservation of Wines.—M. Pasteur.

Absorption-Spectra of the Vapours of Sulphur, Selenious Acid, and Hypochlorous Acid.—D. Gernez.

Isomers of Trichlorhydrine—Reproduction of Glycerine.—C. Friedel and R. D. Silva.—After first briefly alluding to some of their former researches on this subject, and reminding the reader that, by the action of chlorine upon the chloride of isopropyl, there are formed two isomeric bodies, a chloride of propylen and methyl-chlor-acetol, the authors in this essay describe at great length the results of their researches made more especially for the purpose of reproducing glycerine from a body not originally obtained from that substance. The authors have now succeeded with the chloride of propylen, which is first converted into trichlorhydrine, and the latter into real glycerine, which, again, has been converted into iodide of isopropyl.

Conversion of Acetone into Hydride of Hexylen (Dipropyl).—G. Bouchardat.—The main object of the results of researches published in this memoir is to prove that pinacone (a body formed from acetone by the action of nascent hydrogen upon that substance) may be converted, under powerfully hydrogenising influences, into a carburetted hydrogen containing double the equivalents of carbon of those contained in acetone. The author describes at great length his modes of experimenting. The body resulting from the reactions is hydride of dipropylen, $C_{12}H_{14}$, and is isomeric with a compound obtained by hydrogenising benzine.

Facts Relating to Diphenylamine.—Ch. Girard and G. de Laire.—The contents of this paper are the same as have been mentioned in our issue of March 1 (vol. xxv., p. 107) as contained in *La Revue Scientifique de la France et de l'Etranger.*

Some Observations on Colourless Bile.—E. Ritter.—The author quotes in this memoir the results of a series of analyses made by him on colourless bile, taken from the gall-bladders of men and animals submitted to autopsy. As an instance of the composition of such bile (as yet hardly ever analysed, since the colourless fluid has been taken to be mucus) we mention here the following, in 1000 parts:—Water, 923·5; salts, 12·4; fat and cholesterine, 6·8; organic matter, 2·1; salts of the bile acids, 55·2. It appears that colourless bile and fatty degeneration of the liver are somehow connected together.

Discovery of a Shoal of Fossil Fish in the Coarse Limestone (Calcaire Grossier) Deposits of Puteaux, near Paris.—Dr. S. Meunier.—The author relates at great length a palæontological discovery of a shoal of fossil fish, *Hemirynchus Deshayesi*, in a limestone quarry near Puteaux.

This number also contains very important papers on meteorology, natural history, and physics.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 5, 1872.

This number contains the following original papers and memoirs:—

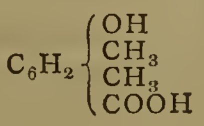
Studies on the Combinations of the Camphor Group.—J. Kachler.—The author treats first on campholic acid, originally discovered by Malin and described by him in *Ann. d. Chem. u. Pharm.*, vol. cxlv., p. 201; it is prepared from camphor by the action of potassium upon it, when dissolved in a petroleum of high boiling-point (130°); the formula of this acid is $C_{10}H_{18}O_2$. When treated with bromine and water, no substitution-product is formed the final result of the reaction being the formation of oxycamphoric-acid-anhydride. With phosphor-chloride, campholic acid forms the compound—

$$C_{10}H_{17}OCl,$$

an oily fluid, decomposed by water. Referring to the results of Delalande's experiments (*Journ. f. Prakt. Chem.*, vol. xxiii., p. 392) on the product of the dry distillation of campholate of lime, an oily liquid, termed by the last-named author campholon, $C_{19}H_{34}O$, the author states that on taking the vapour density (not determined by Delalande) he found it did not agree with that formula, and that campholon is nothing else than impure campholen, C_9H_{16}, also described by Delalande, the author having also prepared pure campholen; campholic acid is rather soluble in water. Camphin acid is next treated of, this body having been prepared, according to Berthelot's method, by the action of caustic potassa upon camphor in alcoholic solution; the acid alluded to is obtained as a sour fluid of syrupy consistency, but, on further investigation, this substance is found to be nothing more than campholic acid mixed with a brittle, resin-like, faintly acid body, which, on being treated with caustic alkali, yields camphor, leaving a terpen-like resin.

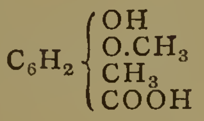
Dextronic Acid.—J. Habermann.—The acid alluded to is formed from dextrin in the same way as lactonic acid is formed from sugar of milk (see Hlasiwetz and Barth, *Ann. d. Chem. u. Pharm.*, vol. cxxii., p. 96), by first treating a solution of dextrin with bromine, and next with oxide of silver; the dilute acid solution is then neutralised with pure carbonate of lime, yielding dextronate of lime, which crystallises, forming aggregates of bright white-coloured very small needle-shaped crystals. This salt is isomeric with the lime salt of gluconic acid, $C_6H_{11}CaO_7+H_2O$. Dextronate of lime is not identical with the salt just named, because it is found to differ in its optical polarisation property.

New Acid from Aloes.—P. Weselsky.—The author found, while preparing orcin from aloes by the action of fusing caustic potassa, a new acid, which is very nearly related to evernic acid in its constitutional formula, that of the new acid being—



$$C_6H_2\begin{cases}OH\\CH_3\\CH_3\\COOH\end{cases}$$

and that of evernic acid—



$$C_6H_2\begin{cases}OH\\O.CH_3\\CH_3\\COOH\end{cases}$$

The new acid is very like gallic acid; it is difficultly soluble in cold water, readily in boiling water, and very readily in boiling alcohol and ether; treated with fusing caustic potassa, the new acid is dissociated, yielding orcin and acetic acid, according to the formula—

$$\underbrace{C_9H_{10}O_3}_{\text{New acid.}}+H_2O=C_7H_8O_2+C_2H_4O_2.$$

The author proposes to name this acid alorcinic acid.

Phenomenon of Affinity According to the Multiples of Common Constant Numbers.—J. Thomsen.—Notwithstanding the very high scientific value of this essay, we can only quote here the headings of the sections into which it is divided—Formation of the oxides of sulphur from their constituents; formation of the oxides of nitrogen; formation of the oxides of manganese; formation of sulphates from their constituents; retrospective review and concluding observations.

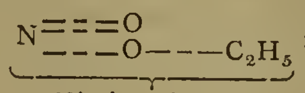
Worthlessness of the Values of the Figures Quoted by Dr. Berthelot and Published by him in his Essay "Sur la Chaleur de Formation des Azotates, sur la Chaleur de Formation des Composés Oxygénés de l'Azote," &c.—J. Thomsen.

Action of Fusing Caustic Potassa upon Braunkohlen.—L. Schinnerer and T. Morawski.—The authors first call to mind the facts that fusing caustic alkalies convert wood (cellulose) into oxalic acid, and charcoal into humus substances, and then state that they were induced to try the effect of fusing caustic alkalies upon braunkohlen from Traunthal (braunkohle is not, we believe, met with in the United Kingdom, and is a less completely converted [in a peculiar sense] mineral than the coal of the genuine coal formation). The result of the action of fusing caustic soda upon this fossil mineral is the formation of a substance of very nearly the composition of pyrocatechin, viz., a body containing in 100 parts—C, 65·45; H, 5·45. The authors further found that the portion of this fossil fuel soluble in ether is that which yields this substance. A series of similar kinds of coal were treated in the same way and gave the same result, but genuine coal of the true coal formation is not at all acted upon by fusing caustic alkalies.

Researches on Derivatives from Glycerine.—L. Henry.—This essay, although styled a preliminary communication, is, notwithstanding its great intrinsic merits, not suited for useful abstraction, mainly owing to the fact that it contains very complex and lengthy formulæ.

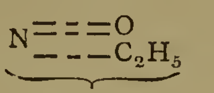
Derivatives of Uramido-Benzoic Acid.—P. Griess.—The second instalment of a monograph on this subject, this portion being divided into the following sections:—Introduction; decomposition of isomeric dinitro-uramido-benzoic acid by liquid ammonia at boiling heat; α-nitro-uramido-benzoic acid, $C_8H_7(NO_2)N_2O_3$; β-nitro-uramido-benzoic acid, same formula as foregoing; γ-nitro-uramido-benzoic acid, also same formula; action of tin and hydrochloric acid upon the isomeric nitro-uramido-benzoic acids; action of concentrated nitric acid upon the isomeric nitro-amido-benzoic acids; α-, β-, and γ-dinitro-uramido-benzoic acids, $C_8H_6(NO_2)_2N_2O_3$; decomposition of isomeric dinitro-benzoic acids by boiling their aqueous solutions; action of tin and hydrochloric acid upon the isomeric nitro-amido-benzoic acids; action of nitrous acid upon the isomeric diamido-benzoic acids; decomposition of isomeric diamido-benzoic acid at a higher temperature.

Preliminary Communication.—V. Meyer and O. Stüber.—The authors first state that according to theory there must exist, although they may not be isolated, two isomeric nitrous acids, but there may exist a series of nitrous acid ethers, the constitution of which corresponds to the nitro-derivatives of the aromatic compounds; for instance—



$$\underbrace{N\begin{matrix}{=}{=}{=}O\\{-}{-}{-}O{-}{-}{-}C_2H_5\end{matrix}}_{\text{Nitrite of ethyl.}};$$

Nitrite of ethyl.



$$\underbrace{N\begin{matrix}{=}{=}{=}O\\{-}{-}{-}C_2H_5\end{matrix}}_{\text{Nitro-ethan (unknown).}}$$

Nitro-ethan (unknown).

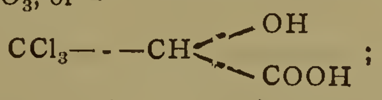
The authors then relate at some length the results of a series of experiments made with the view to prepare such bodies; for this purpose dry nitrite of silver was caused to act upon iodide of amyl, the result being the formation, among other substances, of a compound—

$$C_5H_{11}NO_2,$$

a fluid boiling at between 150° and 160°—that is to say, an isomeric nitrite of amyl. The authors continue these researches.

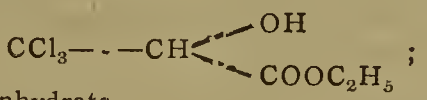
Constitution of Croton-Chloral.—A. Pinner.—Notwithstanding the scientific merits of this memoir, its contents are not suited for any useful abstraction.

Trichlor-Lactic Acid and Trichlor-Angelactinic Acid.—C. Bischoff and A. Pinner.—The first portion of a monograph on this subject, divided into the following sections:—Introduction; trichlor-lactic acid, $C_3H_3Cl_3O_3$, or—



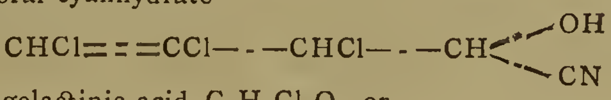
$$CCl_3{-}{-}{-}CH{<}\begin{matrix}OH\\COOH\end{matrix};$$

ammonium, potassium, sodium, and zinc salts of this acid; ethyl-ether—



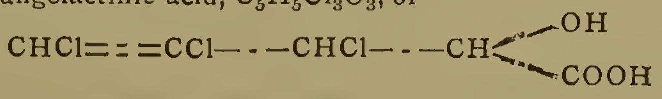
$$CCl_3{-}{-}{-}CH{<}\begin{matrix}OH\\COOC_2H_5\end{matrix};$$

croton-chloral-cyanhydrate—



$$CHCl{=}{=}{=}CCl{-}{-}{-}CHCl{-}{-}{-}CH{<}\begin{matrix}OH\\CN\end{matrix}$$

trichlor-angelactinic acid, $C_5H_5Cl_3O_3$, or—



$$CHCl{=}{=}{=}CCl{-}{-}{-}CHCl{-}{-}{-}CH{<}\begin{matrix}OH\\COOH\end{matrix}$$

Les Mondes, March 21, 1872.

Agricultural Instruction (Enseignement Supérieur d'Agriculture).—J. Dumas.—At the suggestion of the eminent *savant* just named, the Minister of Public Instruction has decreed the formation of a school of superior agricultural instruction, in connection with and at the well-known celebrated Ecole Centrale des Arts et des Manufactures at Paris, to which is also to be added a professorship of theoretical and practical artillery science.

Report on the Researches and Experiments Made by the Spectroscopic Association of Italy.—H. Tarry.—This paper bears excellent testimony to the fact that united Italy is rapidly advancing in science, to which men of all parties and creeds largely contribute, and not the least so the eminent Societatis Jesu Socii.

Memoir on the Employment of Secondary Currents for the Purpose of Accumulating or Transforming the Effects of the Galvanic Battery.—M. Gaston-Planté.—The continuation and end of this essay.

Newly-Devised Experiment for Demonstrating the Mechanical Cause of the Ebullition of Water.—F. Marco.—The lengthy description of an experiment made for the purpose of demonstrating that air is the mechanical cause of the phenomenon of ebullition of water, and that, as soon as the air is completely removed from that liquid and access of air prevented, the ebullition of water does not take place at all, even if it be heated to 148°.

Ventilating Caloriferes.—Dr. J. Casse.—This paper, illustrated by several woodcuts, contains the detailed description of an apparatus (a kind of stove) the use of which gives the following results:—Continuous supply of fresh air at a conveniently high temperature; great saving of fuel; simplicity of construction; while, lastly (what is of importance in schools, churches, courts of law, &c.), the sonorous waves of the air of the room where this apparatus is used are gently but completely forced downwards from the ceiling, so that less effort and less strength of voice is required on the parts of the speakers.

Le Moniteur Scientifique Quesneville, No. 363, March, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Study on the Quantitative Estimation of Phosphoric Acid in all Products of Agricultural Interest and those belonging to the domain of Physiology.—Dr. Joulie.—The first instalment of a very lengthy and complete essay on this subject, which is treated so as to be useful to practical chemists as well as agriculturists; but the great length of this memoir prevents us, notwithstanding its intrinsic value, from entering here into any further details.

Anthracen and its Derivatives.—Dr. E. Kopp.—The continuation of this exhaustive monograph. This portion contains the following sections:—Action of oxychloride of carbon upon anthracen; action of sulphuric acid upon anthracen and its derivatives; sulphanthracenic acid; sulphanthraquinonic acid and its salts; bisulphanthraquinonic acid; sulphoxy-anthraquinonic or sulphalizarous acid.

Disulpho-Anthracenic Acid.—C. Mayer.—The acid here named—

$$C_{14}H_{10},2SO_3=C_{14}H_8\left\{\begin{matrix}SO_3H\\SO_3H\end{matrix}\right.$$

was prepared by the author from previously purified commercial anthracen, which was next treated with sulphuric acid, 4 parts to 1 of anthracen; but the crude disulpho-anthracenic acid thus obtained as a brown-black coloured mass is very difficultly rendered pure, and can only be so made by a rather circuitous process of first making a lead salt of it, and converting this into a baryta salt, and that again into a soda salt, which crystallises in small acicular shape, is yellow-coloured, and readily soluble in water. The pure disulpho-anthracenic acid obtained from the pure baryta salt is a red-coloured crystalline body, very soluble in water and yielding a brilliantly red-coloured solution.

Industrial Preparation of Anthracen.—M. Audouin.—In this paper the author, Directeur Gérant of the Paris Gaslight Company, describes at length a process by which, on the large scale, the greater part of the anthracen contained in coal-tar may be obtained and purified at gas-works. The main features of the process are the combination of distillation and refrigeration (Carré's apparatus), followed by a series of refining operations. The process has been patented in France and other countries.

Preparation of a Pulverulent Manure from Human Fœcal Matter.—F. Jean.—The author describes a process which mainly consists in adding to the *bourbasse* (that is to say, the contents of a tank, or water-tight cistern, which communicates with the *lieux d'aisances*, and wherein no water is poured except urine, forming, with the fæces, a liquid of which a litre weighs about 1050 grms.; *bourbasse*, in Belgium known as *beer*, a Flemish word largely used for liquid manuring) upon 100 parts, 10 parts of strong sulphuric acid, and next 13 parts of coprolites at 45 per cent of tribasic phosphate. After the mass has been well stirred, there is added, to 50 parts of sawdust, and next 27 parts of sifted coal, wood- or peat-ash, when, after some few days, according to the state of the weather, the mixture is dry and pulverulent, and found to consist, on analysis, in 100 parts, of—Water driven off at 100°, 14·8; organic matter and water driven off at 200°, 53·6; mineral matter, 31·6. This manure contains 1·554 per cent of nitrogen and 1·867 of soluble phosphates.

Washing Mixture.—Dr. Quesneville.—The very common use, especially in England, of soda for washing linen is very injurious to the tissues, and, moreover, has the effect of yellowing it in the long run. The author states that in Germany and Belgium the following mixture is now extensively and beneficially used:—2 lbs. of soap are dissolved in 25 litres (5·5 gallons) of water as hot as the hand can bear it; there are next added to this fluid three large-sized tablespoonfuls of liquid ammonia and one spoonful of best oil of turpentine. These fluids are incorporated rapidly by means of beating the soap-suds and other fluids with a small birch-broom. The linen, &c., is then put into this liquid and soaked for three hours, care being taken to cover the washing-tub witb a closely-fitting wooden lid; by this means the linen is readily cleansed, requires hardly any rubbing, and less brushing, and there is a saving also of time and fuel. Ammonia does not affect the linen nor woollen goods, and is largely used as washing-liquor in the North of England, of course along with much water as above indicated.

MEETINGS FOR THE WEEK.

Monday, April 15th.—Medical, 8.
—— London Institution, 4. Mr. E. J. Hopkins, "On Music."
Tuesday, 16th.—Civil Engineers, 8.
—— Zoological, 9.
—— Royal Institution, 3. Dr. W. A. Guy, F.R.S., "On Statistics, Social Science, and Political Economy."
Wednesday, 17th.—Society of Arts, 8.
—— London Institution, 7. Prof. Barff, on "Colour."
Thursday, 18th.—Chemical, 8. Mr. E. A. Letts, on "A Compound of Sodium and Glycerine," and "On Benzyl-Isocyanate and Isocyanurate." "Notes from the Laboratory of the Andersonian University."
—— Royal, 8.30.
—— Royal Society Club, 6.
Royal Institution, 3. Dr. Tyndall, LL.D., F.R.S., "On Heat and Light."
—— Zoological, 4.
Friday, 19th.—Royal Institution, 9. A. Vernon Harcourt, Esq., F.R.S., "On the Sulphurous Impurity in Coal-Gas and the Means of Removing it."
Saturday, 20th.—Royal Institution, 3. R. A. Proctor, Esq., B.A., "On Star-Depths."

NOTES AND QUERIES.

Tungsten Compounds.—Would any of your correspondents kindly inform me of the name of the makers of tungstic acid, or the products of tungsten (such as tungstate of soda, barytes, &c.)?—Nemo.

Atmospheric Air.—(Reply to "Subscriber.")—Asbestos is not well suited for the purpose you name, on account of not possessing the suppleness and elasticity of fibre, and thus not permitting the formation of very small interstices for the air to be sifted through; but you can easily try a comparative experiment, and thus settle this point fully; perhaps you can get the very long-fibred Bohemian asbestos, which is like raw silk, and is used for being woven into asbestos cloth.

NOTICE TO AMERICAN SUBSCRIBERS.

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The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

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THE CHEMICAL NEWS.

Vol. XXV. No. 647.

SECOND REPORT
OF THE
ROYAL COMMISSION
ON
SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.*

To the Queen's Most Excellent Majesty.

May it please Your Majesty,—We, the Commissioners appointed by Your Majesty to make inquiry with regard to Scientific Instruction and the Advancement of Science, humbly beg leave to present to Your Majesty the following Report on Scientific Instruction in Training Colleges and Elementary Day Schools under the Education Department, and in Science Classes under the Science and Art Department.

I. Scientific Instruction in Training Colleges and Elementary Day Schools.

State of Instruction prior to the Introduction of the Revised Code.

In dealing with the scientific instruction in training colleges and elementary day schools, your Commissioners have, in the first place, inquired what provision was made for such instruction before the introduction of the Revised Code in 1861.

In order to show more distinctly the state of scientific instruction in training colleges and elementary schools before 1861, extracts are given from the evidence of the Rev. Dr. Rigg, Principal of the Wesleyan Training College, Westminster, and of the Rev. Cannon Cromwell, Principal of St. Mark's College, Chelsea.

Influence of the Revised Code upon Scientific Instruction.

We now proceed to consider the influence of the Revised Code of 1861, which introduced the system of individual examination, proposed in the Minute of 1853. While we approve the principal that the grants to schools should be determined to a considerable extent by the results of individual examination, we are of opinion that the limitation of such examination to the subjects of reading, writing, and arithmetic unfortunately narrowed the instruction given in elementary schools; and that this change, together with the lower standard adopted in the training and examination of pupil teachers, and the curtailment of the syllabus of the training colleges, exercised a prejudicial effect on the education of the country.

The general apprehension inspired by these changes rendered the profession of schoolmaster less popular. The education of the pupil teachers was generally impaired, fewer candidates were apprenticed, and the number of those who resorted to the training colleges fell off.

It is right, however, to point out that the consequences to which we have referred have been in part obviated by the operation of the system introduced by the Science and Art Department. So strong was the conviction of the principals of certain of the training colleges, that elementary scientific knowledge was of great value to their students, that, in the absence of any assistance from the Education Department, they prepared their students for the May Examinations of the Science and Art Department, and permitted them to attend those examinations, thus qualifying themselves to earn grants under that department.

Among the impediments to higher instruction in training colleges, besides the restricted range of the syllabus of studies, the absence of sufficient indication of the objects and limits of the examination papers is also the subject of important evidence from Dr. Rigg and Canon Cromwell. Dr. Rigg represents that the principals or committees of training colleges have slender opportunities of making any "deliberate representations upon the subject to the Committee of Council." We are of opinion that occasional conferences on the syllabus might be useful, in giving the department the aid of the practical experience of principals, of inspectors, and of men of science.

The New Code of 1871.

The New Code of 1871 does not affect the training colleges except so far as relates to religious inspection, and, from the evidence we have taken, we fear it will practically have little effect in widening the range of the education in elementary schools; that, as heretofore, the grants will, in future, be almost wholly given for reading, writing, and arithmetic; and that little encouragement will be afforded to the study of other subjects, even of history and geography.

It is obvious that if 75 per cent of the children pass in reading, writing, and arithmetic, the school will earn the maximum grant, and, in fairly good schools, this amount of success has been, and we doubt not will be, attained without difficulty. Nor do we think it would be desirable that the standards should be raised in such a manner as to reduce the passes below this proportion; such a course would, we think, tend to discourage both the masters and pupils. The last Report of the Education Department shows that the existing schools did, in fact, earn last year almost the full grant, without any assistance from the extra subjects, and those schools which are unable to pass the children in the elementary subjects are certainly not likely to be successful in others of a more advanced character.

We do not wish to underrate, in any way, the necessity of careful instruction in reading, writing, and arithmetic, as the very foundation of education; but we do not believe that the introduction of extra subjects would in any way interfere with it.

Although we are not at present prepared to recommend any change in the existing system under which the number of extra subjects is limited and the choice left to the school managers, we trust that the time may not be far distant when it may be possible to introduce a more systematic programme of instruction in elementary science.

Meanwhile, we submit that the scale of payments in boys' and girls' schools might be so arranged as to encourage the regularity of the attendance of the scholars; to promote the employment of a sufficient staff of teachers; and to ensure the success of the teaching of the three elementary subjects, while a sufficient reward was given for proficiency in the extra subjects. Even without altering the maximum of 15*s*., we conceive that scales of payment might be adopted by which it would be possible to afford adequate encouragement to humble rural schools; to increase the general intelligence of the scholars in all schools, and thus to make success in the teaching of the rudiments more certain, while the range of instruction was enlarged, and the standard raised.

General Observations.

From a consideration of the evidence we are of opinion that instruction in the elements of natural science can be, and eventually ought to be, made an essential part of the course of instruction in every elementary school.

The instruction to which we refer, though scientific in substance, should, in form, be devoid of needless technicality, and should be almost wholly confined to such facts as can be brought under the direct observation of the scholar. It should, in fact, be conveyed by object lessons, so arranged and methodised as to give an intelligent idea of those more prominent phenomena which lie around every child, and which he is apt to pass by without notice.

A course of object lessons of the nature here indicated

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* Abridged.

could be given even to the junior classes of elementary schools, not only without in any way interfering with the efficiency of other instruction, but with the effect of aiding the general development of the intelligence of the children; and similar advantages would attend teaching of a like kind, but of a somewhat more advanced character, in the senior classes.

The scientific instruction thus afforded would, within the narrow limits to which it extends, give a sound acquaintance with the elements of physical science. It would, therefore, possess very considerable intrinsic value, especially in localities in which classes under the Science Department have not been established; while in those places in which science classes are accessible, it would render the additional service of preparing the scholars for them, and thus enable the teachers to raise the standard of their instruction.

It is of great importance to remember that in order to render the scientific instruction in elementary schools as successful as possible, the teachers must not only have acquired the needful amount of scientific knowledge, but must also have been carefully trained in the special methods of teaching science.

A reasonable hope may be entertained that, as the methods of instruction are improved, and the skill of the principal and assistant teachers increases, the standard reached by very young children in infant schools may be much raised without any undue pressure. Moreover, if some of the principal objects for which the Education Act of 1870 was passed be attained, the greater regularity of the attendance of children at school; the economy of time attained by better teaching, and a larger staff of teachers; and the prolongation of the school age; will afford greater facilities for the introduction of elementary scientific instruction in the sense already explained.

In any case, there can be no good reason why such elementary scientific instruction as has long been given in the Primary Schools of Germany and Switzerland should not be bestowed upon English children.

The London and Liverpool School Boards have recently determined to make elementary physical science and social economy essential subjects in all the schools which they provide, and their example will not improbably be followed by other school boards.

While we are clearly of opinion that scientific instruction should form a substantial part of the curriculum of training colleges, we feel the great difficulty which arises from the present condition of the general instruction in those colleges, as disclosed by the Reports of the Inspectors for the years 1870-71.

We fear that an extension of the curriculum, so as to include elementary science, could not be expected to succeed until the means of scientific instruction for the students are more complete, and until the students enter in a better state of preparation, or remain a longer period.

On the other hand, the extension of the time of education in training colleges would obviously raise questions of expense both with respect to the buildings and annual outlay. These questions may bring under consideration the expediency of adopting, to a greater or less extent, the alternative of instruction without board.

Before we leave this part of the subject, we think it expedient to state that the encouragement of instruction in the rudiments of natural knowledge in elementary schools falls properly within the province of the Education Department, and should be adequately provided for in the regulations of the Code issued under its authority.

Recommendations.

I. We recommend, as regards the elder children in the elementary schools, that the teaching of such rudiments of physical science as we have previously indicated should receive more substantial encouragement than is given in the regulations of the New Code.

II. We recommend, as regards the younger children, that Her Majesty's Inspectors should be directed to satisfy themselves that such elementary lessons are given as would prepare these children for the more advanced instruction which will follow.

III. We recommend that the mode of instruction of pupil teachers; the conditions of admission to training colleges; the duration of the course of study in them; and the syllabus of subjects taught, should be so modified as to provide for the instruction of students in the elements of physical science.

II. Scientific Instruction in Science Classes under the Science and Art Department.

This system has given a remarkable impulse to elementary scientific teaching throughout the United Kingdom, some indication of which will be gathered from the following table, showing the number of schools and persons under instruction in successive years:—

	Number of Schools.	Number under Instruction.
1860	9	500
1862	70	2,543
1864	91	4,656
1866	153	6,835
1867	212	10,230
1868	300	15,010
1869	523	24,865
1870	799	34,283

Teachers.

We feel that the experience and skill of even an uncertificated teacher, and the previous literary training of certificated teachers, qualify them to acquire an elementary knowledge in the existing elementary science classes wth a greater degree of success than inexperienced students. When they take charge of science classes, the skill they have acquired in giving instruction cannot fail to increase their success as teachers, especially in promoting the development of the intelligence of the pupils.

There are, according to a recent return, 311 private teachers, who are not day school teachers, of whom 259 are persons having other employments in the daytime. These occupations are commonly those of tradesmen's clerks, surveyors' assistants, draughtsmen, mechanics, or handicraftsmen, or persons employed in such trades as dyeing or calico printing. In these last, the work affords some opportunities for acquiring skill in chemical manipulation. It is probable that, notwithstanding the want of training in the management of classes, and in teaching, and the occasional want of literary qualifications, many of these teachers have rendered valuable service. We are also informed that 79 hold honorary science certificates; that 33 of them obtained certificates according to the method of examination in use previously to 1867; and 176 have qualified according to the system now in use by passing in the advanced classes at the May examinations, while 23 hold the certificates awarded in consequence of the examination previously to 1867 in some subjects, and have qualified in other subjects at the present May examinations by passing in the advanced classes. We have no information as to what is the relative scientific knowledge of the several classes of teachers.

The steadily increasing stringency of the examination, ensured both by the character of the questions and the requirements of the examiners as to the answers, has doubtless had considerable influence on the qualifications of the teachers. The operation of the system has been marked by a progressive improvement in the answers to the examination papers.

While the increased stringency of the examinations to which we have already referred supplies a powerful motive to the teachers to improve themselves, an important opportunity of such improvement is afforded by the system recently introduced by the Department of supplying courses of lectures in the metropolis, with opportunities of practical instruction, which science teachers are aided in attending by a grant towards their expenses.

We are of opinion that the arrangements for the instruction of teachers have already been of material benefit, though as yet they have been attended by no great number of teachers; and that they may be continued and extended with every prospect of advantage.

We have had before us certain of the examiners: from them we have derived the impression already recorded, that substantial advantages result from the system of instruction pursued; but from the considerable proportion of failures which occur, as well as from the character of the answers given, the examiners are under the impression that a very large part of the instruction is derived from books, tested and aided by the class examinations of the teachers; and that it is not often illustrated by specimens or experiments, the use of apparatus, or the out-door study of nature. One of the examiners even complains that it is clear that the common expedient of the black-board and chalk is not used to illustrate instruction in geology. We have it in evidence that not only is scientific apparatus wanting, but that too often the teachers confine their instruction to the same routine of book learning and class questioning with which alone they were made familiar in the rudimentary classes in which they received their own imperfect elementary knowledge.

The examiners conclude that when there is a great preponderance of failures in any school, the teacher has systematically endeavoured to prepare his students by an almost exclusive exercise of the memory. Mr. Iselin confirms this impression by reporting that "this defect is most observable in science classes established in connection with, and for the pupils of, elementary schools, where the students are more immediately under the control of the teacher. In order to produce good results, the *youth*, and often the deficiency in primary education of his pupils, compels the teacher to cultivate their memory rather than their intelligence." Teachers of elementary day schools are, as we have already observed, under strong inducements to found evening science classes, and the transfer of scholars immediately from the day to the evening schools is one chief means of filling those classes.

Inspection.

There are only two permanent inspectors of local schools of science and art, and as their inspection extends to the art as well as to the science classes, it is obvious that their supervision must be inadequate to provide any important check against irregularities, or to greatly influence the methods and means of instruction.

The Engineer officers are employed as local inspectors, their only duty being to see that the regulations of the Department are complied with. They are not charged to report upon the methods of instruction adopted by the teachers, as to the degree in which that instruction is limited to text-books, and to class examinations, founded upon such book instruction, nor as to the comparative skill and knowledge of method, or assistance from apparatus or specimens, by which the success of the teaching may be promoted. But a system of inspection embracing these objects, yet without proceeding to systematic individual or class examination, would be of great value as a supplement to the May examination of the papers of the pupils.

Practical instruction in the science classes would be greatly promoted by more frequent inspection, followed by reports on the methods and apparatus employed, and the number of pupils receiving such practical instruction.

Payments on Results.

Payments are made by the Department on account of each successful student of the industrial classes, at the rate of £1 for every second class, in either the elementary or the advanced stage; of £2 for a first class in either of these stages, or for a second class in honours; and of £4 for a first class in honours. Although we do not think that either the times of attendance or the amount and sources of contributions in elementary schools can be strictly compared with those in science classes, it may be worthy of observation that the elementary schools are required to be open 400 times, and no grant is made for the elementary instruction of any boy or girl who has not attended 250 morning or afternoon meetings of the school, whereas the science classes are only required to be open 25 times in the year. The cost per head of teaching each scholar in an elementary school, calculated on the average attendance, ranges from 21s. to 30s.; but the average rate of grant was reduced by the operation of the Revised Code from 12s. 3d. to 8s. 6d. or 9s. per scholar, and the maximum grant attainable under the New Code cannot exceed 15s., nor can it exceed one-half the sum raised by fees and subscriptions.

The expenses are defrayed by school pence and contributions. We have grave doubts whether equivalent subscriptions could, at an early period, have been raised in support of the most improved forms of teaching in the elementary science classes. Nevertheless, we think it worthy of the consideration of the Department whether means could not be adopted to increase the resources of the elementary science classes by greater payments from the pupils, and by local contributions. This will become necessary in proportion as practical instruction is introduced. Though, in the earliest period, to have required local contributions, bearing some proportion to the grants, might have prevented the establishment of the classes, that danger ought, if the instruction is valued, gradually to cease to exist.

General Remarks.

The efficiency of the instruction given in the science classes has been diminished, on the one hand, by the imperfect organisation of the classes, whether considered separately or in groups, and the absence of practical teaching; and, on the other, by the irregular and unsystematic manner in which scholars have taken up the subjects taught.

As an example of the efficiency of scientific instruction as an instrument in the education of boys belonging to the humbler middle classes, and from twelve to fifteen years of age, the Commissioners describe the Bristol Trade School, which was successfully developed under the guidance of the late Canon Moseley, who, both as a Professor at King's College, London, and subsequently as an Inspector of Training Colleges, had prolonged experience of such instruction.

As an example of the grouping of classes for the purpose of introducing the services of more efficient teachers, a brief sketch is given of the organisation of a group of evening classes formed in East Lancashire.

As a remedy for the irregular and unsystematic manner in which students take up subjects for the study of which they are unprepared, the Science and Art Department on Nov. 24, 1871, issued a Minute suggesting the adoption of definitely arranged courses of instruction, and offering encouragement in the form of extra payments to the schools in which such courses are adopted. This minute will be of especial service to the teachers themselves, who have hitherto been in the habit of qualifying themselves successively in different subjects without sufficient regard to their connection.

The undeveloped state of elementary education, and the defects of the only machinery available for the establishment of these classes, rendered necessary the experiment of employing whatever rooms and teachers were at hand. The degree of success attained in the enterprise of thus boldly opening, in spite of all obstacles, a path for the introduction of a system of elementary scientific instruction, is greatly due to the vigorous and able administration of the Department, and to the efficiency with which the examinations have been conducted.

The ground thus prepared may hereafter be occupied, step by step, with elementary science schools in well-constructed buildings, supplied with proper apparatus, and a sufficient staff of trained teachers. These schools may train assistant teachers, may group around them humbler classes, and aid them with apparatus and superintendence or instruction.

The first steps have been taken with such vigour, and the result has been to such an extent successful, that we confidently expect that, with needful guidance and encouragement, a thoroughly efficient system of elementary scientific instruction for the working classes may, ere long, be founded on this basis. Our recommendations show in what way, in our judgment, the existing system should be further developed.

Recommendations.

IV. We recommend that the instruction in elementary science classes under the Science and Art Department, be so arranged as to work in complete harmony with the general system of public elementary education, but, at the same time, we consider it important that the Education Department and the department charged with instruction in science shall continue to be co-ordinate.

V. We recommend that a more efficient inspection of elementary science classes be organised, and that the inspectors should advise the local committees and report on:—

(*a*). The apparatus of instruction.
(*b*). The state of the discipline and methods.
(*c*). The general efficiency of the arrangements.

VI. We recommend that teachers who have already qualified by passing the May examination in either of the advanced classes shall continue to be recognised as qualified to conduct elementary science classes, with the title of *Elementary Science Teacher*, and to earn the grants awarded by the Department of Science and Art on the results of the examination of their scholars; but that this qualification and title shall in future only be attainable by passing in the first of the advanced classes.

VII. We recommend that should such arrangements as are hereinafter set forth for conducting the practical instruction of teachers, and for providing for them practical examination at several centres, be adopted, all elementary science teachers shall, after such practical instruction, be admissible to a further examination, which, in all suitable subjects, shall be practical. We recommend that success in this examination shall entitle a teacher to a certificate of *Second Grade Science Master*.

VIII. We recommend that, as an inducement to teachers to prepare for and pass this further examination, payment for results in the case of a Second Grade Science Master be made at a somewhat higher rate than in that of the elementary science teacher.

IX. We recommend that an examination, both by papers and by practical tests, in any group of allied subjects defined by the department which the candidate may select, shall be open to all those teachers who have passed in the advanced classes, or who have been otherwise admitted as science teachers; and that success in this examination shall entitle the candidate to receive a certificate of *First Grade Science Master* in that group.

X. We recommend that a greater capitation grant be payable in respect of the scholars of a first grade science master teaching in any group of allied subjects with or without assistance, than in respect of the scholars of a second grade science master, provided that the Inspector report that the apparatus is sufficient, and that practical instruction has been given in each suitable subject.

XI. We recommend that, with a view of maintaining uniformity of standard in these examinations, they shall be conducted at the several local centres by the staff of examiners acting under the Science and Art Department.

XII. We recommend that the more systematic training of the teachers of science referred to be provided for—

(*a*). By the adoption of special arrangements for this purpose in the science school which has been referred to in our first Report; and by the recognition by the Department of similar arrangements for the instruction of this class of students in any university or college, and in science schools as hereinafter described.

(*b*). By giving to the students of training colleges the opportunity of remaining a third year, during which scientific instruction may either form a principal part of the curriculum of such colleges or be accessible in some adjacent college or school of science approved as efficient for that purpose.

XIII. We recommend that the Science and Art Department be at liberty to dispense with the preceding examinations and to accord the privilege of first and second grade science masters in consideration of university examinations in science, or of a satisfactory course of study in Colleges in which science is taught, as well as in other cases of obvious scientific qualification.

XIV. We recommend that in schools recognised as science schools, as hereinafter set forth, facilities for the employment of assistant teachers be afforded as an experiment on a limited scale, some addition being made to the emoluments of the teacher in consideration of the instruction afforded; provided the Department be satisfied, on the report of an Inspector, that such assistant teacher has received practical instruction in subjects in which it is prescribed, and that he has been actively engaged in teaching.

To encourage the more advanced scholars to become assistant teachers under first grade masters in such schools, a small stipend, rising in successive years, might be granted on condition that a like sum was raised locally, subject to such conditions as the Department might deem expedient. The proportion of assistant teachers should not exceed one for every fifteen successful scholars in any science school, and no scholar should be recognised as an assistant teacher until he has passed in the first division of the elementary class in the May examination.

XV. We recommend that, with a view of training first grade science teachers, exhibitions of sufficient value and in sufficient numbers be offered to elementary science teachers and to assistant teachers who have served three years and passed in the first division of the advanced class in the May examinations; and that such exhibitions should be tenable in any university, college, or science school recognised in Recommendation XII.

XVI. We recommend that the grants made by the Science and Art Department for buildings be extended, under sufficient guarantees, so as to embrace institutions for scientific instruction, although they may not be built under the Public Libraries Act or be in connection with a school of art.

XVII. We recommend that grants similar to those now made for apparatus be given for laboratory and museum fittings under proper guarantees.

XVIII. We recommend that, whenever the arrangements for scientific teaching in any institution shall have attained a considerable degree of completeness and efficiency, such institution be recognised as a science school, and be so organised as to become the centre of a group of elementary science classes; and to provide the assistance of first grade science masters, the loan of apparatus and specimens, and the means of instruction in the laboratories and museums to the more advanced students of the group.

XIX. We recommend that assistance be given for the formation and maintenance of such science schools by special grants, the conditions of which shall be determined by regulations to be framed by the Science and Art Department.

XX. We recommend that when laboratories are attached to second grade grammar schools in the schemes issued by the Endowed Schools' Commissioners, the trustees of such schools be encouraged and enabled to invite the formation of elementary science classes, to be taught therein.

All of which we humbly beg leave to submit for Your Majesty's gracious consideration.

(*Signed*)
Devonshire. W. Sharpey.
Lansdowne. G. G. Stokes.
John Lubbock. Henry J. S. Smith.
J. P. Kay-Shuttleworth. *T. H. Huxley.
Bernhard Samuelson.

(* The Chairman has been authorised by Professor Huxley to affix his signature to this Report.)

J. Norman Lockyer, Secretary.

March 22nd, 1872.

SUPPLEMENTARY REPORT
TO
FIRST REPORT.

To the Queen's Most Excellent Majesty.

May it please Your Majesty,—We, the Commissioners appointed by Your Majesty to make inquiry with regard to Scientific Instruction and the advancement of Science, humbly beg leave to present to Your Majesty the follow- Report on the Organisation of the Science School referred to in our First Report, and on the accommodation of that School in the new buildings at South Kensington.

I. *Organisation.*

Your Commissioners recommend that the science school be represented before the Board of the Science and Art Department by its Dean, as the Royal School of Mines has been hitherto represented by its Director.

We recommend that the council of professors shall have power, subject to the approval of the Board, to provide for the due maintenance of discipline in the general school and technical schools; the discipline of the students of the Royal School of Naval Architecture and Marine Engineering remaining under the principal of that school.

We consider that such modifications as to the conditions of admission to the courses, as well as such re-arrangement of the courses as may be rendered expedient by the consolidation of the schools recommended in the First Report of the Commission, should be considered and reported on to the Committee of Council on Education by the Council of Professors, due regard being had to the maintenance of its character as a school for special scientific instruction. Such re-arrangement should admit of provision being made for the continuance and extension of the instruction given to elementary science teachers during the summer months.

With reference to the assistance required by the professors, we recommend that this subject should also be considered by the Council of Professors and reported on by them to the Committee of Council on Education, due regard being had to the necessity of practical instruction, and to the suggestion in the previous paragraph concerning the instruction to be given to science teachers.

II. *Accommodation.*

Your Commissioners find that the new buildings at South Kensington will afford sufficient space as regards lecture theatres, class rooms, and laboratories, for the theoretical and practical instruction of a large accession of students. A committee of your Commissioners have inspected the new buildings with special reference to the accommodation that will be afforded, and the Secretary, at their request, has applied to the several professors for information as to the space that they require.

The Committee having reported the results of their inspection and inquiry, your Commissioners suggest the following general appropriation, considering that the detailed allotment of rooms had better be left to the professors themselves:—

Basement	Physics, Metallurgy, Chemistry
Ground Floor	School of Naval Architecture, General Lecture Room, Mathematics, Applied Mechanics, &c.
First Floor	Physics and Chemistry.
Second Floor	Chemistry.
Third Floor	Biology, Mineralogy, Mining, Geology, Physics, Chemistry (open air work).

All which we humbly submit for Your Majesty's gracious consideration.

(*Signed*)
Devonshire. W. Sharpey.
Lansdowne. G. G. Stokes.
John Lubbock. Henry J. S. Smith.
J. P. Kay-Shuttleworth. *T. H. Huxley.
B. Samuelson.

(* The Chairman has been authorised by Professor Huxley to affix his name to this Supplementary Report.)

J. Norman Lockyer, Secretary.

February 28, 1872.

CONTRIBUTIONS TO THE HISTORY OF THE OPIUM ALKALOIDS.*

By C. R. A. WRIGHT, D.Sc.,
Lecturer on Chemistry in St. Mary's Hospital Medical School.

Part V.

I. *On the Polymerides of Codeia.*

In Part IV. of these researches reasons have been adduced for the following general conclusions, viz., that codeia and morphia are capable of forming polymerides (with the elimination of methyl in the case of codeia in some instances), which yield derivatives containing certainly not less than C_{68}, and probably not less than C_{136} (C_{72} and C_{144} in the case of those codeia derivatives where methyl has not been eliminated). Experiments now in progress tend to show that the formulæ of codeia and morphia are really double of those formerly ascribed to these bases, *i.e.*, are—

$$C_{36}H_{42}N_2O_6 \text{ and } C_{34}H_{38}N_2O_6$$

respectively, the proof of which is (as will be shown in a subsequent communication) that the first products of the action of hydrochloric acid on these bases appear to contain chlorine and carbon in the proportions C_{36} and Cl, C_{34} and Cl respectively, instead of C_{18} and Cl, or C_{17} and Cl. It might be anticipated, therefore, that intermediate polymerides might be formed containing respectively,—

Morphia series.		Codeia series.	
Monomorphia.. ..	$C_{34}H_{38}N_2O_6$ ..	$C_{36}H_{42}N_2O_6$	Monocodeia.
Dimorphia	$C_{68}H_{76}N_4O_{12}$ ..	$C_{72}H_{84}N_4O_{12}$	Dicodeia.
Trimorphia	$C_{102}H_{104}N_6O_{18}$ ..	$C_{108}H_{126}N_6O_{18}$	Tricodeia.
Tetramorphia.. ..	$C_{136}H_{152}N_8O_{24}$..	$C_{144}H_{168}N_8O_{24}$	Tetracodeia.

In the case of codeia these anticipations have been verified.

In order to obtain these supposed polymerides before their further alteration by secondary reactions, the action of acids other than the hydracids was examined. Acetic acid seemed a probable agent for this purpose; but no appreciable quantity of anything different from ordinary codeia was obtained after sixty-four hours' digestion at 100° of one part of this base with three parts of glacial acetic acid. On precipitation of the product by Na_2CO_3 in large excess, extraction with ether, and agitation of the ethereal extract with HCl, a crystalline mass was obtained which developed a smell of acetic acid on standing in contact with a slight excess of HCl; but on analysis this gave numbers agreeing with those required for codeia hydrochlorate, and from it nothing different from codeia could be obtained; probably, therefore, only a trace of acetyl-codeia was formed.

The action of phosphoric acid, however, was found to lead to the desired result without the formation of by-

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* A Paper read before the Royal Society.

products beyond colouring-matters formed by the high temperature employed; by heating codeia with 3 parts glacial phosphoric acid and 5 of water for several hours at 100°, no perceptible change is produced. The same result follows on boiling for twelve hours (boiling-point 105°) with an inverted condenser attached to prevent loss of water by evaporation; but if the boiling-point be allowed to rise slowly from evaporation, the mixture being very gently boiled in a long-necked flask, the product gradually acquires the power of giving an immediate amorphous precipitate with Na_2CO_3; no large amount of new substances are, however, formed until the boiling-point has risen to about 200°, beyond which point the evaporation cannot safely be pushed. The viscid chestnut-coloured liquid, while still hot, is dissolved in boiling water and allowed to cool; nothing separates on cooling; when cold, the liquid is nearly neutralised by caustic soda, and then precipitated with Na_2CO_3; the precipitate is collected on filters, drained from mother-liquors, dissolved in weak HCl, and re-precipitated by Na_2CO_3, to get rid of traces of unaltered codeia mechanically retained; finally, the drained precipitate is exhausted with ether. The ethereal solution yields on agitation with HCl a crystalline hydrochlorate, which may be purified by solution in water, fractional precipitation with Na_2CO_3 and repetition of the ether process, and, finally, by re-crystallisation of the resulting hydrochlorate.

The portion of the first Na_2CO_3 precipitate insoluble in ether is dissolved in HCl, and fractionally precipitated by Na_2CO_3, to remove colouring-matters as much as possible; the last precipitate, after thorough washing and drying, forms a light buff-coloured amorphous powder that does not soften at 100° when perfectly dry, but clots to a resinous mass if heated in the water-bath while still moist; it is soluble in alcohol, is precipitated from this solution on addition of ether, and yields salts that have no vestige of crystalline characters.

Both the crystalline and the non-crystalline hydrochlorates yield on analysis numbers identical with those required for codeia hydrochlorate; for the reasons developed in the subsequent sections, they are regarded as respectively di- and tetra-codeia.

The filtrate from the original Na_2CO_3 precipitate contains much unaltered codeia; by extracting with ether and agitation of the extract with excess of phosphoric acid solution, a mixture of phosphates is obtained, from which a further quantity of each polymeride is obtainable by simply boiling down the liquid till the boiling-point reaches 200°.

The hydrochlorate of tetracodeia obtained as above described forms a brownish brittle tar not fusible at 100° when dry; dried at 100° it yields the following numbers:—

Specimen A. 0·325 grm. gave 0·773 CO_2 and 0·186 H_2O.
" B. 0·3145 " " 0·732 " 0·185 "
0·1215 " " 0·0495 AgCl.

	Calculated.		Found.	
			A.	B.
C_{144}	1728	64·38	64·87	63·48
H_{176}	176	6·56	6·36	6·54
N_8	112	4·17		—
O_{24}	384	14·30		—
Cl_8	284	10·59		10·08
$C_{144}H_{168}N_8O_{24},8HCl$	2684	100·00		

The free base gave the following numbers:—

0·8095 grm. gave 0·818 CO_2 and 0·190 H_2O.

	Calculated.		Found.
C_{144}	1728	72·24	72·08
H_{168}	168	7·02	6·82
N_8	112	4·68	
O_{24}	384	16·06	
$C_{144}H_{168}N_8O_{24}$	2392	100·00	

In appearance and most physical properties tetracodeia and its salts bear a great resemblance to chloro- and bromo-tetracodeia; and they further agree in that all yield a blood-red colour on warming with silver nitrate and nitric acid, or with nitric acid alone; it differs from chlorotetracodeia in that the aqueous solution of the hydrochlorate does not precipitate on the addition of strong HCl, the salt being apparently as soluble in diluted HCl as in water; also the free base does not oxidise so readily. In all respects tetracodeia agrees with the description given by Anderson of his "Amorphous Codeia"* obtained by the action of sulphuric acid on codeia; on comparison with the product obtained by Anderson's process, no essential differences could be detected between the two substances, except that the phosphoric acid product was somewhat darker in tint, owing no doubt to the presence of colouring-matters from the higher temperature employed in its production.

The hydrochlorate of dicodeia obtained as above described crystallises with $3H_2O$ for every C_{18} contained, this water of crystallisation being wholly lost at 100° and partially by standing over sulphuric acid.

	Grms. per cent.
2·163 grms. of crystals dried on filter-paper lost at 100°	0·295
Actual loss..	= 13·63
Calculated for .. .. $C_{72}H_{84}N_4O_{12},4HCl+12H_2O$	= 13·86
2·012 grms. of crystals that had stood three days over SO_4H_2 lost, at 100°, 0·172 ..	= 8·54

Dried at 100°, these crystals gave these numbers:—

0·306 grm. gave 0·719 CO_2 and 0·182 H_2O.
0·3135 " 0·742 " 0·194 "
0·229 " 0·098 AgCl.

	Calculated.		Found.	
C_{72}	864	64·38	64·08	64·54
H_{88}	88	6·56	6·61	6·88
N_4	56	4·17	—	
O_{12}	192	14·30	—	
Cl_4	142	10·59	10·60	
$C_{72}H_{84}N_4O_{12},4HCl$	1342			

Na_2CO_3 throws down from the solution of the hydro chlorate white amorphous flakes that do not oxidise spontaneously in the air. Dried at 100°, 0·2965 grm. gave 0·7765 CO_2 and 0·189 H_2O.

	Calculated.		Found.
C_{72}	864	72·24	71·43
H_{84}	88	7·02	7·08
N_4	56	4·68	
O_{12}	192	16·06	
$C_{72}H_{84}N_4O_{12}$	1196	100·00	

If the solution of the hydrochlorate be concentrated, the addition of Na_2CO_3 solution throws down tarry globules consisting of a mixture of the base and its hydrochlorate, the salt being sparingly soluble in the NaCl solution formed by the decomposition.

Dicodeia and its salts do not yield a blood-red colour with NO_3H, only a slight orange tint; Fe_2Cl_6, also—

$$SO_4H_2+K_2Cr_2O_7,$$

give no colour reactions.

In general properties, and in the fact that water of crystallisation possessed by the hydrochlorate is lost at 100°, dicodeia bears a great resemblance to the "isomer of codeia" obtained by Drs. Matthiessen and Armstrong by the action of diluted sulphuric acid on codeia.† On comparison with the product obtained by Armstrong's process, no difference whatever was discernible provided the hydrochlorate obtained by the action of sulphuric acid, &c., were several times re-crystallised; the crude hydrochlorate contains, besides the dicodeia salt, the hydrochlorate of another polymeride, which differs from dicodeia

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* Anderson, *Ed. Phil. Trans.*, vol xx. (1), p. 57.

† *Journal of the Chemical Society* (ii.) vol. ix., p. 56.

hydrochlorate in that it is non-crystalline, drying up to a gummy, extremely hygroscopic and deliquescent substance; it yields a blood-red colour with NO_3H, and with—

$$SO_4H_2 + K_2Cr_2O_7$$

a very evanescent purplish-red; Fe_2Cl_6 gives no colouration at first, but on standing, a reddish-purple tinge appears, gradually becoming more intense. Na_2CO_3 throws down an amorphous white precipitate, which is soluble in ether, and but little changed by exposure to air. From these properties, which seem to be analogous in some respects to dicodeia, in others to tetracodeia, the base is considered to be intermediate between these two polymerides, *i.e.*, to be *tricodeia.* The crude hydrochlorate of dicodeia obtained by Armstrong's process on re-crystallisation furnished mother-liquors which, on standing over SO_4H_2 for several weeks, gradually deposited crystals, and finally became a crystalline mass wetted with a viscid non-crystalline liquid; by gentle pressure in filter-paper the liquid portion was separated from the crystals, which were found to be only dicodeia hydrochlorate; and finally, the treacly hydrochlorate of tricodeia was extracted from the papers by water. On repetition of the treatment over SO_4H_2, no crystals were obtained even after several weeks' standing; at 100° a brittle, gummy, hygroscopic substance was obtained, of which—

0·309 grm. gave 0·730 CO_2 and 0·191 H_2O.
0·208 ,, 0·0895 AgI.

	Calculated.		Found.
C_{108}	1296	64·38	64·43
H_{132}	132	6·56	6·87
N_6	84	4·17	—
O_{18}	288	14·30	—
Cl_6	213	10·59	10·64
$C_{108}H_{126}N_6O_{18},6HCl$	2013	100·00	

II. *Action of Hydrochloric Acid on the Polymerides of Codeia.*

(*a*). *Tetracodeia.*—Tetracodeia hydrochlorate was boiled for six hours with a large excess of strong HCl; no perceptible evolution of methyl chloride took place; and on examining the resulting product no change was found in the ratio of carbon to chlorine. Hence no substitution of Cl for OH had taken place, and apparently no action at all had ensued.

(*b*). *Tricodeia.*—Tricodeia hydrochlorate was heated to 100° for 1¼ hours with a large excess of strong HCl; on adding water to the product, a tarry substance was precipitated, whereas the original tricodeia hydrochlorate is readily soluble in dilute HCl; precipitated by Na_2CO_3, and the precipitate exhausted with ether, a viscid non-crystalline hydrochlorate was obtained on agitation of the ethereal extract with HCl. The reactions of this product appear to be identical with those of tricodeia, excepting that the reddish-purple tinge with Fe_2Cl_6 appears instantaneously instead of only after standing a short time. Dried at 100°,

0·3070 grm. gave 0·756 CO_2 and 0·185 H_2O.
0·2480 ,, 0·1150 AgCl.

	Calculated.		Found.
C_{108}	1296	68·03	67·16
H_{120}	120	6·30	6·69
Cl_6	213	11·18	11·48
N_6	84	4·41	
O_{12}	192	10·08	
$C_{108}H_{114}N_6O_{12},6HCl$	1905	100·00	

Hence this product has been formed by the reaction—

$$C_{108}H_{126}N_6O_{18},6HCl = 6H_2O + C_{108}H_{114}N_6O_{12},6HCl,$$

and has the composition of a polymeride of "apocodeia." From the great similarity observed between this product and "apocodeia" made by Matthiessen and Burnside's process*, it appears probable that the product of the action of zinc chloride on codeia is a mixture of bodies of general formula $(C_{18}NH_{19}O_2)_n,nHCl$, in which the derivative where $n=6$ greatly predominates; experiments on the action of zinc chloride on morphia now in progress in conjunction with Herr L. Mayer indicate that mixtures are obtained in this case also.

(*c*). *Dicodeia.*—When pure dicodeia hydrochlorate is heated to 100° for one hour with a large excess of HCl, a change is produced expressible by the equation—

$$C_{72}H_{84}N_4O_{12},4HCl + HCl = C_{72}H_{83}ClN_4O_{11},4HCl + H_2O,$$

which shows that the formula of this polymeride contains at least C_{72}. Na_2CO_3 throws down from the product a voluminous white precipitate, which differs in appearance slightly from that of dicodeia, and turns green by exposure to air; ether dissolves this precipitate, and on agitation with HCl a viscid hydrochlorate is obtained which does not crystallise, but dries up to a gum. Fe_2Cl_6 gives a brown-purple tint, NO_3H a blood-red, and—

$$K_2Cr_2O_7 + SO_4H_2$$

a lighter blood-red, none of which reactions occur with the original dicodeia. Dried at 100°,

0·3200 grm gave 0·737 CO_2 and 0·189 H_2O.
0·3260 ,, 0·172 AgCl.

	Calculated.		Found.
C_{72}	864	63·50	62·82
H_{87}	87	6·39	6·56
Cl_5	177·5	13·04	13·06
N_4	56	4·12	
O_{11}	176	12·95	
$C_{72}H_{83}ClN_4O_{11},4HCl$	1360·5	100·00	

(To be continued).

ON A DOUBLE CHLORIDE OF NICKEL AND AMMONIUM.

By ISAAC ADAMS, Jun., and J. M. MERRICK.

The literature of the double salts of cobalt and nickel with alkalies is rather scanty. We subjoin some notes upon the double chloride of nickel and ammonium, a salt which we have still under examination.

Tuffuti (*Ann. de Chimie*, vol. lxxviii., p. 169), speaking of this double salt, says, "since we are not able to wash it properly, by reason of its solubility, and since it does not crystallise regularly, I dare not affirm with certainty its existence." Tuffuti's salt was made by mixing chloride of nickel with sal-ammoniac.

Hautz (*Ann. der Chem. u. Pharm.*, vol. lxvi., p. 283) says that "by Tuffuti's method are obtained crystals in the form of star-like twins, which are composed of heaps of tetrahedrons whose analysis shows a small amount of nickel, varying according to the lighter or darker yellow colour of the stars. This salt varies in accordance with the density of the liquid from which it is crystallised.

We were ignorant of Hautz's researches—any farther than they are noticed in Gm. Eng. Ed., vol. v., p. 383, when we began our experiments, which had for their end the preparation of a tolerably pure double chloride of nickel and ammonium.

Our salt was prepared as follows, viz.:—

Equivalent amounts of pure, re-crystallised, and air-dried double sulphate of nickel and ammonia, and chemically pure fused chloride of barium dried over sulphuric acid, were weighed out, dissolved, the solutions mixed, the sulphate of baryta filtered off, and the green filtrate made to crystallise over sulphuric acid at the ordinary temperature under the bell-jar of an ordinary air-pump.

After three weeks, a large amount of barley-candy coloured crystals were obtained, looking like grains of wheat stuck together in stellate forms—probably Hautz's "stern-formigen Zwilligen"—whose aspect was so curious,

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* *Proc. Roy. Soc.*, vol. xix., p. 71.

especially as we expected to obtain bright green prismatic crystals, that we immediately made some analyses of the crystals, after washing them with cold water and drying at the temperature of the eir.

The yellow salt can likewise be obtained in large stellate clusters, and quite free from lemon-yellow cubes, by evaporating a large amount of the solution obtained by double decomposition to about 30° Beaumé, and allowing it to cool very slowly.

The yellow crystals are soluble in about 2 parts of water at 100° C.

The nickel was determined as such in the following way:—

A quantity of the salt was weighed in a bright platinum crucible, and therein dissolved in a very little hot water, and a few drops of ammonia added. The crucible was then made the cathode of a galvanic circuit, and being covered with a perforated porcelain cover, the anode—a slip of platinum—was lowered through the hole in the cover so as just to dip into the liquid, and the circle was thus completed. About two hours was found sufficient to deposit—with two medium Grove's cells—all the nickel from ½ or ¾ grm. of the salt.

The chlorine was determined as chloride of silver, &c.

The air-dried salt was found to contain just 1 per cent of mechanically-combined water, and the following results are corrected for that amount:—

(*a*). 1 grm. of yellow salt, dried at 100° till a constant weight was attained, gave 0·99 grm. of dry salt = 1 per cent loss, or water.

(*b*). 0·5 grm. of yellow salt gave 1·2237 grms. of chloride of silver = 0·3022 grm. of Cl = with 1 per cent correction, 61·07 per cent.

(*c*). 0·25 grm. of yellow salt gave 0·626 grm. of chloride of silver = 0·1545 of Cl = with 1 per cent correction, 62·41.

(*d*). 0·2 grm. of yellow salt gave 0·195 grm. of Pt = 0·0355 of NH_4 = with 1 per cent correction, 17·92 per cent.

(*e*). 1·0775 grms. of yellow salt gave 0·069 grm. of metallic Ni = with 1 per cent correction, 6·49 per cent.

(*f*). 1·136 grms. of yellow salt gave 0·0735 grm. of metallic Ni = with 1 per cent correction, 6·47 per cent.

(*g*). 0·4255 grm. of yellow salt gave 0·0265 of metallic Ni = with 1 per cent correction, 6·30 per cent nearly.

(*h*). 0·413 grm. of yellow salt gave 0·026 grm. of metallic Ni = with 1 per cent correction, 6·35.

In (*g*) and (*f*) the same yellow crystals were used as in the other determinations, but the corked tube containing them had lain in the sun, and some water having been observed to be liberated, the tube was repeatedly shaken, to re-distribute, if possible, this moisture; and its unequal distribution probably makes the percentage of nickel vary.

In another experiment, 2 atoms of anhydrous chloride of nickel were dissolved with 1 atom of pure chloride of ammonium, and the green solution crystallised over oil of vitriol.

It gave a cake of crystals in two layers firmly united; the lower, the yellowish, confused tetrahedrons, and the upper, larger confused prisms, of an emerald green colour. The whole was crushed between filter-paper, and the green crystals separated mechanically as far as possible.

An analysis of the green crystals resulted as follows, viz.:—

(*i*). 0·3205 grm. of green crystals gave 0·0535 grm. of metallic nickel = 17·0 per cent.

The liquid from the above determination, and free from nickel, was evaporated to dryness on the water-bath. to determine directly the amount of chloride of ammonium present.

Assuming that in the deposition of the metal there was no loss of chlorine as hypochlorous acid, which seems impossible, as the solution was kept strongly alkaline with ammonia, this method should give the chloride of ammonium with exactness.

(*j*). 0·3205 grm. of green crystals gave 0·1335 grm. of NH_4Cl = 41·71 per cent – 0·098 due to the NiCl = 38·56 per cent.

Hautz's formula for the double chloride of nickel and ammonium, $NH_4Cl,2NiCl,12HO$, calculated with more recent atomic weights than he used, requires 19·10 per cent of chloride of ammonium and 19·96 per cent of nickel (an amount of metal which was very nearly reached in another sample of the green salt which we prepared).

In another experiment, the green salt was freed from the mechanically-adhering yellow crystals, dried between blotting-paper, and then for half an hour over sulphuric acid. It gave as follows, viz.:—

(*k*). 0·4515 grm. of green salt gave 0·088 grm. of nickel = 19·49.

(*l*). 0·572 grm. of green salt gave 0·111 grm. of nickel = 19·40.

(*m*). The liquid in analysis (*l*), freed from nickel, was evaporated in a water-bath, and dried alternately in the water-bath and over sulphuric acid until a constant weight was obtained.

0·572 grm. of green crystals gave 0·3295 grm. of chloride of ammonium, which, less 0·2105 grm. due to the chlorine of the chloride of nickel, gives 0·119 grm. = 0·04 grm. of ammonium = 6·97 per cent.

Hautz's formula requires 6·19 per cent.

(*n*). 0·313 grm. of green crystals gave, by battery process, 0·0595 grm. of metallic Ni = 19·0 per cent.

(*o*). 0·3025 grm. of green crystals, dried at 100° C. until a constant weight was obtained, lost 0·110 grm. of water = 36·36 per cent.

Hautz's formula, reckoned with the more recent atomic weights, requires 37·17 per cent.

Our results with the better sample of the green salt may be compared with Hautz's figures and the theoretical percentages, as follows, viz.:—

		Theory.	Hautz.	A. and M.		
2Ni	58·0	19·96	20·05	19·71	19·40	19·00
3Cl	106·5	36·66	36·44			
NH_4	18·0	6·20	5·65	6·97		
12HO	108·0	37·18	37·86	36·36		
	290·5	100·0	100·00			

It is hardly possible to doubt the identity of the two salts.

As these yellow tetrahedrons, of a form at once remarkable and striking, were obtained several times—every time, in fact, that we attempted to make a double chloride of nickel and ammonium—we were led to believe that they must have a fixed composition, and we therefore essayed to construct a formula from our analyses.

A salt containing 1 atom of nickel, 8 of chlorine, 4 of ammonium, and 7 of water, would have percentages as shown below, which may be compared with the results of our analyses, viz.:—

			Theory.	A. and M.			
Ni	=	29 =	6·47	6·49	6·47	6·30	6·35
8Cl	=	284 =	63·39	61·07	62·41		
$4NH_4$	=	72 =	16·08	17·92			
7HO	=	63 =	14·06	14·52			
		448	100·00	100·00			

We have not been able to construct from these figures any satisfactory rational formula.

When this yellow salt is dissolved in water and recrystallised, it gives crystals in the form of cubes, pale straw-yellow, and which give on analysis only about 1·5 per cent of metallic nickel. The tetrahedrons sometimes occur mixed with these pale yellow cubes, from which they can be readily separated mechanically.

We have examined samples of a commercial double chloride of nickel and ammonium (so-called) since making the preceding experiments.

It consists of masses of the barley-candy coloured stellate tetrahedrons, mixed with greenish-yellow confused crystals of another form and some chloride of ammonium. There can be no doubt that these tetrahedrons are the salt we have analysed, or that they are mixed with some other salt, perhaps Hautz's chloride.

Hautz's paper, which is entitled "Ueber einige isomorphe Doppelsalze des Chlorammoniums mit Chlormetallen aus der Magnesium-reihe," is written to show that there exist two series of salts, viz.:—

$$NH_4Cl, 2CoCl, 12HO.$$
$$NH_4Cl, 2NiCl, 12HO.$$
$$NH_4Cl, 2MgCl, 12HO.$$

and

$$NH_4Cl, 2MnCl, 4HO.$$
$$NH_4Cl, 2ZnCl, 4HO.$$
$$NH_4Cl, 2CuCl, 4HO.$$

It does not treat of nickel especially. It is significant that Hautz had difficulty in preparing both the magnesium and the nickel salt, owing, as he says, to the tendency of the sal-ammoniac to crystallise out by itself, or with very small percentages of metal.

He also had trouble in obtaining the double cobalt salt, which, as well as some curious double bromides, we are now investigating.

Hautz describes the cobalt salt ($NH_4Cl, 2CoCl, 12HO$) as "Schöne rüben-rothe—prachtvolle," which is probably the case; but there is no question, theoretically, that a cobalt salt corresponding to the yellow nickel tetrahedrons would be *blue*.

We cannot help adding one word in regard to determining metals by the battery. It seems to us that, so far as our experience goes, this elegant method is not so much used as its merits deserve. Take, for example, nickel. A very eminent chemist tells us that he calls it good work when his best pupils make their nickel determinations, made in the ordinary way, agree within one-half of 1 per cent. On the other hand, with ordinary care, the determinations made by depositing nickel on platinum should never vary except in the second decimal place.

In fact, with the same solution, it is hard to make them vary more than a few hundredths of a per cent. This method has been often set forth as excellent, but it deserves a wider use and application than it now enjoys.—*American Chemist.*

ESTIMATION OF NITROGEN BY COMBUSTION.

By JOHN RUFFLE.

In making determinations of nitrogen by combustion with soda-lime, and conversion of the nitrogen into ammonia, some anomalous results recently obtained have induced me to make some experiments, the results of which show that not only is the nitrogen present in a substance as salts of ammonia, albuminous matters, &c., determinable, but the nitrogen present as a nitrate can be made to show in analysis. In nitrogen combustions as often performed, the nitrogen present as a nitrate is partially determined, in addition to the nitrogen present as ammonia, &c. I find that, by modifications of the present way of conducting a nitrogen combustion, about 80 per cent of the nitrogen present in a substance as nitrate can be determined, whether present in conjunction with ammoniacal salts or alone. Results obtained by experimenting with a simple nitrate have, under certain circumstances, yielded me as much as 94 per cent of the nitrogen converted into ammonia, and warrant the inference that by careful research it will be possible to determine by combustion the whole of the nitrogen present as a nitrate in addition to the nitrogen otherwise contained.

The advantages of a process that will enable one to determine the nitrogen present as nitrate will be most apparent in agricultural chemistry, where the principal sources of nitrogen (as a manure) are Peruvian guano, sulphate of ammonia, and nitrate of soda; the market value of these rule the prices of all other sources of nitrogen, but the nitrogen in the shape of Peruvian guano (at its present quality) or sulphate of ammonia is approximatively 20 per cent dearer than that of nitrate of soda, and is also more limited in supply. If we are able to readily determine the nitrogen present in manures as nitrates, it is evident that nitrate of soda, an acknowledged valuable fertilising agent, may, with advantage to the farmer, be employed by manure manufacturers where it is now passed over, because it is not estimated by ordinary analysis.

This conversion of the nitrogen of nitrates into ammonia by "combustion" is one not in accordance with text-books, and I shall be glad if your correspondents will inform me of any analysis (if such exist) pointing in the same direction.

2, Church Villas, Church Street,
Plaistow, E.

CORRESPONDENCE.

ORIGINAL RESEARCH.

To the Editor of the Chemical News.

Sir,—All who take an interest in the progress of science must feel greatly indebted to Dr. Frankland for so eloquently pleading, at the last Anniversary Meeting of the Chemical Society, for the *recognition* of original research.

A man knows that if he can only manage by *coach* or *cram* to partially answer some of a series of so-called test-questions, he will receive such recognition as will help him better to engage in the struggle for existence: this is his incentive, and the cause of an enormous amount of encyclopædic work being done. But while hosts are labouring at this species of work, Nature waits investigation—she offers a rich harvest to all willing to take up her cause, but labourers slowly enter her fair fields, not so much from want of inclination or power of doing the higher kind of work as from the absence of the above-mentioned incentive. It may be argued that the Fellowship of the Royal Society is a recognition of original research: as a rule it may, perhaps, be so considered, but the power of influence, and the heavy costs pertaining to the honour, must always prevent it from acting as a general incentive to investigation.

It might be wished that existing examining bodies would take the initiative in this matter. When, however, a reform is required, it is almost useless to attempt to get help where invested interests are concerned, especially when the possessors of such are incapable of understanding the spirit of the reform demanded. To petition our Universities would be, in the present science period, waste of much energy and cause of delay. Why cannot the recognised societies take the initiative? Why, for example, cannot the Chemical Society, taking cognizance as it does of physical and general chemistry, confer some distinction on its Fellows who distinguish themselves in some branch of that science. Alarmists and possessors of invested interests will say it would cause the disruption of the Society. I firmly believe that it would be the means of adding to its prosperity and usefulness, and do as much for our science as has been done by Dalton's grand conception of the atomic constitution of matter.—I am, &c.,

A. T.

April 9, 1872.

MISCELLANEOUS.

The Royal Polytechnic.—We understand that the Professorship of Chemistry at this Institution has been accepted by Professor Gardner, F.E.S. The laboratories and chemical theatre will be well filled with all the accessories necessary for a school of science, and such measures taken as will render the scientific department a valuable part of the Institution.

Piperidine from Amyl Derivatives.—We are informed by our Glasgow correspondent that Dr. T. E. Thorpe, in conjunction with Mr. M. M. Pattison Muir, F.C.S., has for some time been engaged in conducting an experimental inquiry with the object of obtaining piperidine, one of the active principles of pepper, from amyl derivatives. The experiments are still in progress, and this preliminary notice of them is made on account of the fact that certain German chemists are engaged in a research which seems to tend in a similar direction.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, March 25, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences :—

Three Memoirs Containing Observations on the means of Preserving, Keeping in Sound State, and Improving, as well as Maturing, Wine.—Respectively by M. de Vergnette-Lamotte, M. Pasteur, and Dr. Thenard.

Injury Caused by Lightning at Alatri (Italy) by Falling on a Lightning-Rod.—Rev. A. Secchi, S.J.—In a letter from Rome, dated March 20, the eminent *savant* gives a detailed account of the very curious effects of lightning which struck a lightning-conductor and, having in a great measure destroyed it, pursued its way along water-pipes, some of which were also destroyed.

Absorption-Spectrum of the Vapours of Sulphur.—G. Salet.

New Class of Combinations of Dulcite with Hydracids.—G. Bouchardat.—The author describes the following compounds :—Chlorhydrate of dulcite, $C_{12}H_{14}O_{12}+HCl+3H_2O_2$, a very unstable crystalline body; it can only be kept in an atmosphere saturated with hydrochloric acid, and is destroyed even by very cold water, dulcite being left. Bromhydrate of dulcite, $C_{12}H_{14}O_{12}+HBr+3H_2O_2$; also an unstable crystalline body, but less readily decomposed than the foregoing. Iodhydrate of dulcite, $C_{12}H_{14}O_{12}+HI+3H_2O_2$, like the two foregoing a solid very unstable crystalline compound, is prepared like them by cautiously bringing dulcite into contact with the hydracids alluded to. The author says it would appear that all these compounds correspond to a hydrate of dulcite, $C_{12}H_{14}O_{12}+4H_2O_2$, which he has not been able to obtain.

Action of Bromine upon Protochloride of Phosphorus.—M. Prinvault.—When protochloride of phosphorus is added to bromine a very violent reaction ensues, but when bromine is added to the protochloride the action is far more calm, and there is gradually formed a compound which, after the excess of bromine has been eliminated, is found on analysis to be composed of PCl_3Br_8, which may be written $PBr_5 3ClBr$, a solid crystalline body, soluble in sulphide of carbon, and also somewhat soluble in protochloride of phosphorus, but decomposed by water, yielding bromine and phosphoric, chlorhydric, and bromhydric acids. The author further details at great length the results of his experiments with various reagents on this body, and the action of a temperature above 90° upon it.

Observations on the Mineral Matter of Plants.—A. Baudrimont.—Since Dr. Sacc recently stated that no chemical relation exists between the organic matter of plants and the ash they contain, the author first wrote to Dr. Sacc on this subject, but the latter persisting in his opinion, and quoting in support thereof the fact that several plants (especially those belonging to the *Cactus*, aloe, sedum, and *Opuntia* tribes) grow vigorously on bare rocks, the author has undertaken a series of analyses, especially with such kinds of plants, with the view to prove—(1) That all plants contain mineral matter (although in some—for instance, the *Cactus Peruvianus*—this quantity is very small indeed, since that plant contains upwards of 95 per cent of water, leaving only 5 per cent for organic and inorganic matter together) (2) that this mineral matter is either simply held in solution in the vegetable juice or fixed by the organic matter, but only as an adhesive union with the fundamental structure of the organic products.

Among the natural history and meteorological papers contained in this number we call attention to a memoir on—

Gonolobus Cundurango.—M. Triana.

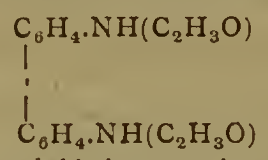
Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 6, 1872.

This number contains the following original papers and memoirs ;—

Composition of Diphenine.—Julie Lermontoff.—In the introduction to this memoir the authoress gives, first, a review of the labours of Gerhardt and Laurent (twenty-five years ago) on diphenine, discovered by them and formulated $C_{12}H_{12}N_4=C_{12}H_8(H_2N)_2N_2$, and then quotes briefly Dr. A. W. Hofmann's researches (*Proc. Roy. Soc.*, vol. xii., p. 644) on this subject. The researches of the authoress were made with the view to ascertain whether or not the diphenine of Gerhardt and Laurent is a hydro-compound, for which purpose the pure body was prepared exactly as directed by the discoverers; on being analysed, the diphenine led to the formula $C_{12}H_{14}N_4$, thereby proving it to be a hydro-compound, which combines with acids, yielding well-crystallised salts, the formula of the hydrochlorate being $C_{12}H_{14}N_4.2HCl$. This essay further treats on the results of the action of hydrosulphuret of ammonium when cold upon dinitro-azobenzol (when the reagent just named is used hot, diphenine is formed); there is formed another body, insoluble in water, difficultly soluble in boiling alcohol, not combining with acids, fusing at 220°. When binitro-azobenzol is similarly treated with hydrosulphuret of ammonium in the cold, hydro-dinitro-azobenzol is formed; formula—

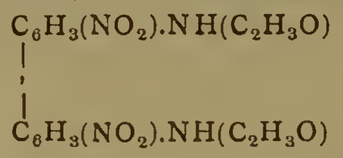
$$C_{12}H_{10}N_4O_4=C_{12}H_8(NO_2)_2N_2H_2.$$

Benzidine.—J. Strakosch.—The contents of this memoir record the researches made with the view of obtaining an amidated benzidine, and the author describes, first, the mode of preparation of acet-benzidine—



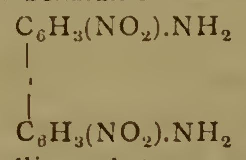
$$\begin{array}{l} C_6H_4.NH(C_2H_3O) \\ | \\ C_6H_4.NH(C_2H_3O) \end{array}$$

a solid crystalline body, insoluble in water, but somewhat readily soluble in boiling alcohol and ether, fuses at 300°, may be sublimed, but only with partial decomposition; dinitro-acet-benzidine—



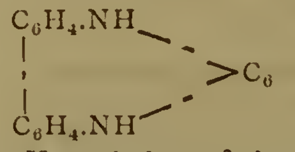
$$\begin{array}{l} C_6H_3(NO_2).NH(C_2H_3O) \\ | \\ C_6H_3(NO_2).NH(C_2H_3O) \end{array}$$

a solid crystalline sublimable body, insoluble in water, readily soluble in boiling alcohol; dinitro-benzidine—



$$\begin{array}{l} C_6H_3(NO_2).NH_2 \\ | \\ C_6H_3(NO_2).NH_2 \end{array}$$

a solid red-coloured crystalline substance, sublimable above 300°; the attempts made to amidate these bodies failed. As an appendix there is added to this memoir a record on the sulphide of carbon combination of benzidine—



Contribution to our Knowledge of the Ethylen Bases.—Dr. A. W. Hofmann.—This exhaustive memoir is divided into the following sections :—Action of sulphide of carbon upon ethylen-diamine; ethylen-diamine-sulpho-carbonate, $C_3H_8N_2S_2=(C_2H_4)H_4N_2.CS$; ethylen-sulpho-carbamide or ethylen-sulpho-urea—

$$C_3H_6N_2S=\left\{\begin{array}{l} CS \\ C_2H_4 \\ H_2 \end{array}\right\}N_2$$

salts of that compound; hydro-sulpho-cyanate of ethylen-diamine, $C_4H_{10}N_4S_2=(C_2H_4)H_4N_2.(HCNS)_2$; ethylen-diamides; action of benzoyl-chloride upon ethylen-diamine; ethylen-dibenzoyl-diamide—

$$C_{16}H_{16}N_2O_2=\left\{\begin{array}{r} C_2H_4 \\ (C_7H_5O)_2 \\ H_2 \end{array}\right\}N_2$$

action of chloral upon ethylen-diamine; ethylen-diformyl-diamide; $(C_2H_4)H_4N_2+2[CCl_3.CHO]=(C_2H_4)(CHO)_2H_2N_2+2CHCl_3$; action of oxalic acid ether upon ethylen-diamine.

Oxidation of Phenol.—H. Wichelhaus.—This paper, as yet only a preliminary communication, contains the results of the author's researches made for the purpose of studying the action of oxidising substances upon phenol. By treating phenol with chromic acid, and purifying the crude product, there was obtained, as first product of the oxidation of phenol, chinon, and also a compound of phenol and chinon, pheno-chinon, which is not further acted upon by chromic acid at the ordinary temperature.

Action of some Amido-Compounds upon Chloral.—O. Wallach.—The contents of this excellent and lengthy memoir are divided into the following sections :—Action of aniline upon chloral; action of toluidine upon chloral; formation of trichloracetic acid from chloral.

On Dichlorhydrine.—A. Watt.—The main gist of this paper is that the observation made by Hübner and Müller (*Ann. d. Chem. u. Pharm.*, vol. clix., p. 168), concerning the formation of two isomeric dichlorhydrines when dichlorhydrine is made by Berthelot's process, is not correct, the author having made a series of experiments to test this point. The paper also contains a short notice on the oxidation of dichlorhydrine.

Drying of Gases.—J. Myers.—We much regret that the contents of this exhaustive and lengthy essay, highly valuable in a scientific point of view, do not admit of useful abstraction. The author calls attention to the fact, accidentally discovered by him, that when so-called dry gases (dried by the best possible means) are caused to pass through boiling sulphur, that substance will give the means of detecting the presence of water in gases which do not chemically act upon sulphur under these conditions.

Description of Lecture Experiments on the Phenomena of Diffusion and for Exhibiting the Specific Gravity of Gases.—F. Fischer.—Illustrated with woodcuts.

On Chinamine, a New Cinchona Alkaloid.—O. Hesse.—While engaged in testing samples of the bark of the *Cinchona succirubra*, now largely exported from British India, the author found therein relatively much chinidine, some quinine, and among other alkaloids one which he terms chinamine, a well-crystallised substance, not containing any water of crystallisation, readily soluble in ether, in warm alcohol, and in petroleum ether (refined benzoline), and insoluble in water, in ammonia, and in caustic potassa; the alcoholic solution exhibits an alkaline reaction. With acids, this alkaloid forms salts, which are readily soluble in water; the chlorhydrate is an amorphous substance, and the neutral sulphate is difficultly obtained crystalline. Chinamine does not exhibit fluorescence of its solutions, and with chlorine and ammonia does not yield the well-known reaction of quinine; in strong sulphuric acid, chinamine dissolves without giving rise (unless heat be applied) to a colouration of that acid; when dissolved in nitric acid, the latter is first turned yellow by the chinamine, and next orange-red, after which the colouration disappears. Chinamine fuses at 172°; it is hardly bitter-tasted by itself, but its salts are somewhat so. The results of an elementary analysis of this new alkaloid will be made public as soon as the author shall have prepared a larger quantity of this material.

Some of the Derivatives of Cymol.—F. Landolph.—Mono-brom-cymol—

$$C_6H_3Br\left\{\begin{matrix}CH_3\\C_3H_7\end{matrix}\right.$$

is a colourless fluid, boiling at from 228° to 229°; sp. gr. = 1·269; by oxidation with nitric acid this compound yields bromo-toluylic acid—

$$C_6H_3Br\left\{\begin{matrix}CH_3\\CO_2H\end{matrix}\right.$$

a solid crystalline body, readily soluble in dilute hot alcohol, ether, and chloroform, but difficultly soluble in water; it fuses at 203° to 204°, and forms readily-crystallisable salts with calcium and barium. When this acid is treated with very concentrated and hot nitric acid, brom-nitro-toluylic acid is formed—

$$C_6H_2(NO_2)Br\left\{\begin{matrix}CH_3\\CO_2H\end{matrix}\right.$$

also a solid body, difficultly soluble in water, but readily so in alcohol, ether, and benzol; before becoming fused at between 170° and 180° this substance is decomposed.

Benzyl-Sulpho Acid.—G. Barbaglia.—Notwithstanding the very high scientific merits of this memoir, it is not suited for useful abstraction, on account of requiring the reproduction of lengthy and complex formulæ.

Preparation of Propargyl Ether.—L. Henry.—By heating upon a sand-bath a flask containing mono-brom-ethyl-allyl ether—

$$(C_3H_4Br)C_2H_5O,$$

along with a very concentrated solution of caustic potassa in alcohol, the author obtained propargyl ether, which has been fully described as regards its properties by Liebermann and Krétschmer (*Ann. d. Chem. u. Pharm.*, vol. clviii., p. 237). The quantity of this ether obtained from 100 grms. of mono-brom-ethyl-allyl ether is about 45 grms. Sp. gr. of propargyl ether at 7° = 0·83; boiling-point, 81° to 85°.

New Product of Decomposition of Commercial Aniline.—R. Braun and Ph. Greiff.—The authors observed that when a large quantity of commercial aniline is distilled along with lime, the last portion of the distillate is not quite freely soluble in hydrochloric acid; further investigation led to the conclusion that the properties of that substance agree with those of carbazol, as described by Graebe and Glaser. Carbazol is present in crude tar oil, but the authors surmise that this substance might be formed by the drying of the mixture of aniline and lime in contact with the very hot metal of the iron still.

Some of the Derivatives of Tetra-Phenyl-Ethylen.—A. Behr.—The author describes at length, and elucidates with some lengthy and complex formulæ, the properties and mode of preparation of—Tetra-phenyl-ethylen oxide, $C_2(C_6H_5)_4O$; tetra-phenyl-ethylen-tetra-sulpho acid; tetra-oxy-tetra-phenyl-ethylen, $C_2(C_6H_4OH)_4$.

Combinations of the Aldehydes with the Phenols.—A. Baeyer.—The author describes in this paper a series of compounds resulting from the reaction of pyrogallic acid upon essential oil of bitter almonds, whereby a solid substance is formed, the formula of which is—

$$C_{26}H_{22}O_7=2C_7H_6O+2C_6H_6O_3=C_{26}H_{22}O_7+H_2O.$$

A combination of the essential oil of bitter almonds with naphthol is—

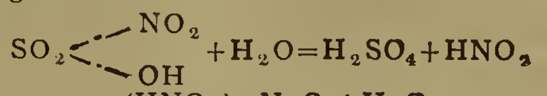
$$C_{34}H_{26}O_3=2C_7H_6O+2C_{10}H_8O=C_{34}H_{26}O_3+H_2O.$$

(1). $C_6H_5.CH_2.\quad C_6H_4(OH)$, benzylated phenol.
(2). $C_6H_5.CH(OH)C_6H_4(OH)$, hypothetical aldehyde compound.
(3). $C_6H_5.CO.\quad C_6H_4(OH)$, benzoylated phenol.

Simple Mercurial Valve.—H. Karsten.—The description, illustrated by a woodcut, of a very efficient and simple mercurial valve for use in various experiments.

Diphenylamine.—Drs. Merz and Weith.—Preliminary communication. The authors treat on a mono- and di-sulpho acid of this base, on the action of oxidising substances upon it, and on acetyl-diphenylamine; and incidentally mention that Dr. E. Kopp uses diphenylamine as a very sensitive test for the detection, as well as quantitative estimation, of nitrous and nitric acids in commercial sulphuric acid.

So-called Leaden Chamber Crystals as a Source of Pure and Cool Nitrous Acid.—M. Streiff.—Since it is well known that the crystals alluded to are, in contact with water, decomposed according to the following formula:—



$$SO_2\left\langle\begin{matrix}NO_2\\OH\end{matrix}\right.+H_2O=H_2SO_4+HNO_2$$

$$2(HNO_2)=N_2O_3+H_2O$$

yielding nitrous acid, the author prepares artificially a mixture (solution) of these crystals by passing sulphurous acid gas in red fuming nitric acid (kept very cold by ice or a freezing mixture), until an oily liquid is obtained; this solution, being poured into a suitable gas-evolving apparatus, yields, by the gradual addition of water, nitrous acid gas.

Analysis of Koumis made at Davos (Canton des Grisons, Switzerland).—Suter-Naef.—Sp. gr. of the fluid at 50° = 1·1286. In 100 grms. are contained—Water, 90·346; alcohol, 3·210; lactic acid, 0·190; sugar, 2·105; albuminates, 1·860; butter, 1·780; inorganic matter, 0·509; free carbonic acid, 0·177.

Action of Essential Oil of Mustard upon Milk.—Dr. Schwalbe.—One drop of the oil alluded to added to 20 grms. of milk prevents the latter being coagulated, even in hot summer weather, for several weeks, but the constituents of the milk so treated become altered, the casein becomes converted into albumen coagulable by heat, and this coagulum is difficultly soluble in concentrated hydrochloric acid; ether precipitates this albumen, but dilute acetic acid does not produce coagulation. The milk became very sour; it would appear that the casein is oxidised.

La Revue Scientifique de la France et de l'Etranger, March 30, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to—

Continuation of Lectures on Animal Heat.—Dr. C. Bernard.—Illustrated with woodcuts.

April 6, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to the following memoirs:—

Histology of the Medulla Spinalis, and its Functions as Organ of Transmission and as Centrum of Innervation.—Dr. Lereboulet.—Illustrated with woodcuts.

Lectures on Animal Heat.—Dr. C. Bernard.

Exploration of the Baltic Sea.—Dr. Moebius.

The American Journal of Science and Arts, March, 1872.

This number does not contain any original papers relating to chemistry.

MEETINGS FOR THE WEEK.

Monday, April 22nd.—Medical, 8.
—— Royal Geographical, 8.30.
—— London Institution, 4. Mr. E. J. Hopkins, "On Music."
—— Philosophical, 6. Anniversary.
Tuesday, 23rd.—Civil Engineers, 8.
—— Royal Institution, 3. Dr. W. A. Guy, F.R.S., "On Statistics, Social Science, and Political Economy."
Wednesday, 24th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 25th.—Royal, 8.30.
—— Royal Society Club, 6.
—— Royal Institution, 3. Dr. Tyndall, LL.D., F.R.S., "On Heat and Light."
—— London Institution, 7.30. Mr. R. Liebreich, "On Turner and Mulready."
Friday, 26th.—Royal Institution, 9. Prof. Blackie, F.R.S.E., "On the Genius and Character of the Modern Greek Language."
—— Quekett Microscopical Club, 8.
Saturday, 27th.—Royal Institution, 3. R. A. Proctor, Esq., B.A. "On Star-Depths."

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THE CHEMICAL NEWS.

Vol. XXV. No. 648.

THE ACTION OF OXYGEN ON COPPER NITRATE IN A STATE OF TENSION.*

By J. H. GLADSTONE, Ph.D., F.R.S., and ALFRED TRIBE, F.C.S.

In our experiments on the action between copper and nitrate of silver in solution, we frequently noticed that the tips of the silver crystals became red, as though coated with a thin layer of metallic copper.

This apparent deposition of a positive on a more negative metal of course raised our curiosity, and led us to look closely into the circumstances under which it occurred. We found that it took place only when the nitrate of silver was exhausted, and only on those silver crystals which remained in metallic connection with the copper. We found too that the cupreous coating formed most readily where air had the freest access, and in fact that it would not form at all in vessels from which oxygen was excluded, nor on those white crystals which were far below the surface of the liquid, though they might be in immediate contact with the copper plate. When an inverted jar was filled with nitrate of copper solution, and silver crystals resting on branches of copper, and the liquid was displaced by oxygen gas, it was found that the tips of the crystals became red, and the solution gradually filled the jar again by the absorption of the gas. In the same way the oxygen was absorbed from air, or from its mixtures with hydrogen or carbonic anhydride.

This action was further studied by employing plates of the two metals instead of copper covered with silver crystals. When the two plates, connected by a wire, were partially immersed in an ordinary aqueous solution of copper nitrate, it was found that a slight yellowish deposit made its appearance speedily all over the silver plate, and went on increasing for a day or two, while at the air-line there was a thicker deposit, which gradually grew and extended itself a little below the surface. This deposit changed from yellowish to red, and under the microscope presented a distinctly crystalline appearance.

Thinking that this slight crust all over the silver plate was due to air dissolved in the solution itself, we took advantage of the reaction to prepare copper nitrate absolutely free from dissolved oxygen. An ordinary solution of the salt mixed with some silver nitrate was placed in a narrow cylinder, with a long piece of copper-foil arranged somewhat spirally, so as to retain the deposited silver on its surface, and allowed to rest for twenty-four hours. The solution thus obtained was exposed to the action of the conjoined copper and silver plates; but even after some hours there was no dimming of the lustre of the silver plate, except at the air-line, which was sharply defined. The same solution, shaken for some time in the air, produced a yellowish deposit on the white metal in three minutes.

The colour and general appearance of this crust, together with its formation only where oxygen can be absorbed, showed that it was not metallic copper, but the suboxide. This was further proved by the action of dilute sulphuric acid, which resolves it at once into red metallic copper and copper sulphate. There is also another curious reaction, which can only be properly observed under a microscope. When treated with a solution of silver nitrate, this cupreous deposit does not give the ordinary crystals of the white metal; in fact, it is only slowly acted upon: but presently there shoot forth thin threads of silver, which run through the liquid, often twisting at sharp angles, while the yellowish crystals change to black. This also was found to be a property of the suboxide of copper.

This deposition of oxide on the silver is accompanied by a corresponding solution of copper from the other plate. Thus in an experiment made with nitrate of copper solution that had been exposed to air, and which was allowed to continue for four days, there was found—

Gain of silver plate, 0·016 grm.
Loss of copper plate, 0·015 grm.

The copper necessary for the production of 0·016 grm. of suboxide would be a little above 0·014 grm.

The wire connecting the two plates in this experiment is capable of deflecting a galvanometer. The current takes place from copper to silver, that is, in the same direction as if the copper had been dissolved by an acid, and hydrogen evolved on the silver plate.

If the two plates have their sides parallel, the suboxide is deposited not merely on that side of the silver plate which faces the copper, but after about a minute on the other side also, showing that in this, as in other cases, the lines of force curve round.

It became interesting to consider what started this electric current. The original observations convinced us that it was not due to the action of oxygen on the copper; but, to make the matter more certain, bright copper and silver plates in conjunction were immersed, the copper in a pure, *i.e.* deoxygenised solution of nitrate of copper, the silver in an oxygenised solution: the two liquids communicated through the diaphragm of a divided cell. In half an hour the silver plate was covered with a reddish film, while not a trace of tarnish was perceptible on the copper. On cleaning the plates, and reversing their position, the copper was oxidised, while the silver remained free from cupreous deposit. We believe, therefore, that, through the simultaneous action of the two metals, the dissolved salt is put into such a state of tension that oxygen brings about a chemical change which otherwise would be impossible, and that this change is initiated in close proximity to the more negative metal.

Though we have examined only this particular reaction, we have satisfied ourselves that it is not an isolated fact. Each of the elements concerned may be replaced by others: thus, the sulphate may be substituted for the nitrate of copper, or platinum may be used instead of silver; chlorine may take the place of oxygen, with the production of the subchloride instead of the suboxide; and zinc may be employed as the positive metal, with zinc chloride as the salt in solution, in which case copper may be taken as the negative metal, and on its surface will form a deposit of oxide of zinc.

CONTRIBUTIONS TO THE HISTORY OF THE OPIUM ALKALOIDS.*

By C. R. A. WRIGHT, D.Sc.,
Lecturer on Chemistry in St. Mary's Hospital Medical School.

(Concluded from p. 187).

III. *Action of Hydriodic Acid and Phosphorus on the Polymerides of Codeia.*

(*a*). *Dicodeia.*—When pure dicodeia is dissolved in a large excess of strong hydriodic acid (55 per cent HI) and heated, together with a piece of phosphorus, to ebullition until the boiling-point rises to 120°, methyl iodide is given off and a considerable quantity of phosphoric acid formed. The product, filtered through asbestos and precipitated with water, yields snow-white flakes that become yellow by exposure to air, and melt to a colourless oil at

---

* A Paper read before the Royal Society.

* A Paper read before the Royal Society.

100° when moist, although they do not fuse at that temperature when thoroughly dried. Dried at 100°,

0·3155 grm. gave 0·5620 CO_2 and 0·1460 H_2O.
0·1895 „ 0·1190 AgI.

	Calculated.		Found.
C_{136}	1632	48·45	48·58
H_{161}	161	4·78	5·14
I_9	1143	33·94	33·92
N_8	112	3·33	
O_{20}	320	9·50	
$C_{136}H_{153}IN_8O_{20},8HI$	3368	100·00	

Hence this substance is formed by the reaction—

$$2C_{72}H_{84}N_4O_{12},4HI+20HI= \\ =I_8+4H_2O+8CH_3I+C_{136}H_{153}IN_8O_{20},8HI.$$

The physical properties of this substance are almost identical with those of the bodies of analogous constitution (containing C_{136}) formerly obtained from both codeia and morphia; carbonate of sodium throws down a precipitate almost insoluble in ether, showing that polymerisation to the tetra-series has taken place; agitated with a large bulk of ether, this precipitate furnishes an extract, which, on agitation with dilute nitric acid and boiling with $AgNO_3$ and NO_3H of the nitrate thus obtained, yields a precipitate of AgI, showing that iodine is contained in the precipitated base. The substance itself boiled with, $AgNO_3$ and HNO_3, produces a deep orange-coloured liquid, intermediate in tint between the blood-red produced by the derivatives of polymerised $C_{17}H_{19}NO_3$, and the deep yellow by those of polymerised $C_{17}H_{21}NO_3$, a result confirmatory to some extent of the formula deduced from the analysis, this being capable of representation as—

$$8(C_{17}H_{20}NO_3)9+9HI-4H_2O.$$

From this it appears pretty evident that the formulæ hitherto attributed to the tetra bases (containing $C_{68}-C_{72}$) are only half the true ones, which contain $C_{136}-C_{144}$.

(*b*). *Tetracodeia.*—On treating tetracodeia in the same way and continuing the ebullition until the temperature reaches 130°, a brown syrupy liquid is finally obtained, which yields, on filtration through asbestos and precipitation with water, a yellow brittle tar not fusible at 100° when quite dry; methyl-iodide is produced in quantity during the action, but only traces of phosphoric acid, and this probably by atmospheric oxidation. Dried at 100° the tar gave these numbers:—

0·3660 grm. gave 0·621 CO_2 and 0·149 H_2O.
0·5520 „ 0·363 AgI.

	Calculated.		Found.
C_{136}	1632	46·31	46·27
H_{158}	158	4·48	4·53
I_{10}..	1270	36·04	35·54
N_8..	112	3·18	
O_{22}..	352	9·99	
$C_{136}H_{150}I_2N_8O_{22},8HI$	3524	100·00	

Hence this substance is formed by the reaction—

$$C_{144}H_{168}N_8O_{24},8HI+10HI= \\ =8CH_3I+2H_2O+C_{136}H_{150}I_2N_8O_{22},8HI.$$

NO_3H and $AgNO_3$ give a blood-red colouration with this product, showing, as the analytical numbers indicate, that it is derived from polymerised $C_{17}H_{19}NO_3$, and not from polymerised $C_{17}H_{20}NO_3$, or $C_{17}H_{21}NO_3$.

The foregoing results show that the methyl group in codeia is unaltered during the polymerisation to dicodeia and to tetracodeia, and furnishes another proof of the conclusion come to in Part IV., § 2, that the addition of H_2 for C_{17}, when HI and P act on morphia or codeia, takes place *before*, and not after, the final polymerisation; even polymerisation to dicodeia could not precede this addition of H_2, as the product obtained from that polymeride has only H added on for C_{17}.

The following formulæ show clearly the difference in the action of hydriodic acid and phosphorus on codeia and its polymerides.

Alkaloid.	Temperature.	Formula of Product.
Codeia..	100°	$8(C_{17}H_{19}NO_3+H_2)+12HI.$
„	110°–115°	$8(C_{17}H_{19}NO_3+H_2)+12HI-4H_2O.$
„	up to 130°	$8(C_{17}H_{19}NO_3+H_2-O)+12HI-4H_2O.$
Dicodeia	up to 120°	$8(C_{17}H_{19}NO_3+H)+9HI-4H_2O.$
Tetracodeia.. ..	up to 130°	$8(C_{17}H_{19}NO_3)+10HI-2H_2O.$

From which it is clear that dicodeia is intermediate between tetracodeia and ordinary codeia. From the fact that 4HI for $8(C_{17})$ are added on in the case of the first product *before* the elimination of $4H_2O$, as in the second substance in the list, it may be inferred that the action is not a true substitution of iodine for hydroxyl; analogous facts have been observed in the chlorinated substances obtained by the action of HCl on codeia and morphia, the first action being apparently a direct *addition* of the elements of HCl, the subtraction of the elements of H_2O taking place at a later stage.

IV. *Action of Sulphuric Acid on Codeia and its Polymerides.*

The results detailed in the previous sections show that the action of sulphuric acid on codeia is to polymerise it, with the formation of di-, tri-, and tetracodeia, the substances obtained by Armstrong and by Anderson by this means being identical with the first and last of these bases; it appears probable that tetracodeia may be formed by the further polymerisation of dicodeia, whereas it would seem as though tricodeia were not likely to be obtained from dicodeia; on the other hand, it is possible that tetracodeia is directly produced from codeia, and that it could not be formed from dicodeia. To settle this point, pure dicodeia was heated to very gentle ebullition with sulphuric acid diluted with its own bulk of water for five hours, the operation being conducted in a long-necked flask so that no appreciable concentration by evaporation took place. At the end of this time the dicodeia was wholly converted into a base, of which ether dissolved only traces; hence no tricodeia was formed. After precipitation by Na_2CO_3 and drying, the free base was dissolved in alcohol and fractionally precipitated by ether. If the alcoholic solution be nearly free from water, the ether throws down solid amorphous flakes; but if 10 or more per cent of water be present, the ether precipitate is a tarry fluid containing water, alcohol, and the base. Flakes of tetracodeia were thus obtained identical in all respects with that obtained by the action of phosphoric acid; a trace of some product of the further action of sulphuric acid appeared to be present, however, as the free base turned slightly green on drying, without, however, absorbing so much oxygen as to make any appreciable difference in its composition. Dried at 100°, 0·221 grm. gave 0·583 CO_2 and 0·142 H_2O.

	Calculated.		Found.
C_{144}	1728	72·24	71·94
H_{168}	168	7·02	7·14
N_8	112	4·68	
O_{24}	384	16·06	
$C_{144}H_{168}N_8O_{24}$	2392	100·00	

If the action of sulphuric acid be pushed further than this point, a smell of SO_2 is perceptible, and the product obtained rapidly oxidises on precipitation by Na_2CO_3 and exposure to air. Nothing fit for analysis was obtained from the product, which probably is formed by the dehydration, oxidation, and possibly de-methylisation of tetracodeia.

V. *On the Physiological Action of the foregoing Polymerides. By* Reginald Stocker, *M.B., Pathologist in St. Mary's Hospital Medical School.*

An aqueous solution of the hydrochlorate of codeia and its polymerides was in each case employed, being subcu-

.aneously injected into adult cats (a dog being also employed in a few experiments), quantities equivalent to 0·1 grm. of the anhydrous salt being used in each experiment. Four cats were employed, several trials being made with each animal, and three or four days being allowed to intervene between each experiment, so that the effects of one dose had entirely passed away and the animal entirely recovered before the administration of another dose. The main results observed were as follow:—

Codeia.—Four experiments. In each instance dilated pupils; cerebral congestion (determined by ophthalmoscopic examination), and much increased reflex excitability (epileptic convulsions in one case); salivation and purging in two cases; vomiting not produced in any case.

Dicodeia.—Two experiments. In each instance vomiting; fundus of eye not congested; pupil dilated in one case.

Another experiment with a dog (full-grown she-terrier) produced salivation and purging without vomiting; no cerebral congestion.

Tricodeia.—Three experiments. In each case salivation (profuse) and dilated pupils; no cerebral congestion; in one case slight excitement; in the others purging and depression; vomiting produced in one of these two latter instances, micturation in the other.

Tetracodeia.—Four experiments. In each case profuse salivation, micturation, and depression; dilated pupils in three instances, and lachrymation in two; in one case vomiting and purging; in another increased reflex excitability with an occasional convulsion (cat was weak and not in good condition); slight hypnotism in two cases.

In two experiments with the dog salivation and depression only were produced.

From these results it would appear that codeia produces cerebral congestion and increased reflex excitability without vomiting; whilst di- and tetracodeia produce profuse salivation and some depression, with vomiting in several instances; no evidence of cerebral congestion and but little of increased reflex excitability being noticeable.

Reagent &c.	Codeia.	Dicodeia.	Tricodeia.	Tetracodeia.
Alcohol.	Soluble.	Soluble.	Soluble.	Soluble.
Ether.	Soluble.	Soluble.	Soluble.	Insoluble.
Character of base.	Crystalline, stable in the air.	Amorphous, stable in the air.	Amorphous. Very slowly oxidises while moist.	Amorphous. Very slowly oxidises while most.
Character of hydrochlorate.	Crystallises with $2H_2O$ for C_{18}; not lost at 100°.	Crystallises with $3H_2O$ for C_{18}; lost at 100°, and partially at lower temperatures.	Non-crystalline, extremely deliquescent.	Non-crystalline, deliquescent.
Ferric chloride.	Nil.	Nil when pure.	No colour at first, reddish-purple on standing.	Reddish-purple colour immediately.
Nitric acid.	Light orange.	Light orange.	Blood-red.	Blood-red.
Potassium dichromate and sulphuric acid.	Nil.	Nil.	Evanescent red.	Evanescent red.
Sodium carbonate and solution of hydrochlorate.	No immediate precipitate, crystals on standing.	Instantaneous amorphous precipitate but little soluble in excess.	Same as dicodeia.	Same as dicodeia.
Caustic potash and solution of hydrochlorate.	Oily precipitate if concentrated, becoming crystalline on standing. Not markedly soluble in excess.	Oily precipitate if concentrated, not becoming crystalline; more dilute solutions give a white amorphous precipitate soluble in large excess.	Same as dicodeia.	Same as dicodeia.
Action of hydrochloric acid not pushed to extreme.	Product contains Cl for C_{36}; further action contains Cl_2 for for C_{36}.	Product contains Cl for C_{72}.	H_2O removed for C_{18}; no basic Cl contained in product.	Nil.
Action of hydriodic acid in conjunction with phosphorus, not pushed to extreme.	Polymerises with elimination of CH_3 for C_{18}, forming bases derived from $(C_{17}H_{21}NO_3)8$, H_2 being added on for C_{17} in product.	Polymerises with elimination of CH_3 for C_{18}, forming bases derived from $(C_{17}H_{20}NO_3)8$, H being added on for C_{17} in product.	—	CH_3 eliminated for C_{18}; product derived from $(C_{17}H_{19}NO_3)s$, *no* H being added on, but simply I substituted for OH.
Action of sulphuric acid, not pushed to extreme.	Polymerises, forming successively di-, tri-, and tetracodeia.	Polymerises, forming tetracodeia.	—	Nil. Further action probably dehydrates and oxidises.
Formula inferred from above properties and reactions.	$C_{36}H_{42}N_2O_6$.	$C_{72}H_{84}N_4O_{12}$.	$C_{108}H_{126}N_6O_{18}$.	$C_{144}H_{168}N_8O_{24}$.
Physiological action of 0·1 grm. of anhydrous hydrochlorate subcutaneously injected into adult cats.	Extreme hypersensitiveness and cerebral congestion, dilatation of pupils; no diarrhœa; no vomiting in any instance.	No hypersensitiveness nor cerebral congestion; dilatation of pupils; vomiting in every instance. With a dog profuse diarrhœa without vomiting.	Hypersensitiveness scarcely marked; vomiting in some instances, in others salivation and defæcation.	No hypersensitiveness; vomiting, salivation, or diarrhœa in every case; great depression. With a dog profuse salivation and depression

VI. *Conclusions.*

The foregoing results suggest the probability of other bases being capable of forming similar polymerides. In anticipation of this result experiments are in progress with morphia.

Hesse has shown* that by the action of HCl on thebaine there are produced two isomerides of that base, one forming crystalline salts, one amorphous salts; not improbably these are respectively dithebaine and tetrathebaine.

Matthiessen and Foster have shown† that cotarnine occurs in crystals of the formulæ—

$$C_{12}H_{13}NO_3+\tfrac{1}{2}H_2O \text{ and } C_{12}H_{13}NO_3+H_2O;$$

and the writer's observations indicate that the former substance is more stable than the latter, which rapidly become more or less coloured; not improbably these two forms are polymerides, the first being $C_{24}H_{26}N_2O_6+H_2O$, the second $(C_{12}H_{13}NO_3)_n nH_2O$. Opianic acid‡, on heating, furnishes an anhydride of formula $C_{40}H_{38}O_{19}$; this tends to show that the formula of this acid is not less than—

$$C_{20}H_{20}O_{10};$$

not impossibly, therefore, the formula of narcotine may be double that usually ascribed to it; from their physical properties it is not improbable that the dimethylnornarcotine, methylnornarcotine, and nornarcotine of Matthiessen may be derivatives not of ordinary narcotine, but of its polymerides.

The different modifications of the cinchona alkaloids are not impossibly polymerides of one another.

The subjoined Table exhibits the principal differences between codeia and the polymerides above described.

THE EVIDENCE OF EXPERTS.

In Philadelphia we have had recently the spectacle of a professed chemist and toxicologist making an examination of the body of a man supposed to be poisoned, and carrying his investigations far enough to convince himself of the presence of antimony, and forgetting there was a jury and a public to be convinced as well, appearing on the witness stand without a particle of proof that he found it, except his bare assertion. The prisoner in this case was acquitted, on the evidence of other experts called for the defence.

In Albany, some twenty years since, a man was hung for poisoning his wife by aconite, on the evidence of a professed chemist, who swore he obtained aconite by a process that never detected it before and never detected it since, and this, notwithstanding that other chemists swore that the process described would, so far from detecting, absolutely prevent the detection of aconite, were it present.

In a recent trade-mark suit, relating to the manufacture of mustard, Dr. Ogden Doremus, of this city, swore that mustard seeds contained over 11 per cent of starch. To prove it, he used a solution of iodine upon mustard placed on filtering paper, which paper gave, when tested, the characteristic reaction of iodine with starch when no mustard was present. The error in the experiment was pointed out by Professors Seely and Chandler. Dr. Doremus was aided by Dr. Austin Flint, who tried to confirm by the use of a microscope what Dr. Doremus tried to prove by the iodine test. Dr. Flint swore that he could see the granules of starch by the use of a high power. Professors Seely and Chandler could not see any such granules, but they did see what they thought might have been fragments of the exterior envelopes of the seeds. Dr. Doremus has, in a letter since published, affirmed the presence of starch in mustard seed (he says nothing of the percentage), and attempted to prove it by a test which would give the same results with cellulose as with starch.

Now, in view of such facts as these, is it any wonder that the public is beginning to mistrust the value of this kind of evidence? Such a mistrust is based upon good grounds enough. As now presented to juries, the testimony of the both competent and imcompetent witnesses only serves to muddle their intellects, and to complicate rather than make plain the facts.

If it be necessary to give juries authoritative instruction on points of law, how can it be less necessary that they should be similarly instructed in matters involving scientific knowledge. To bring before them A, who swears to one thing and swears to the truth, and then bring B, the charlatan, who looks and talks twice as wisely as A, and denies under oath all that A has asserted, is not to instruct, but to mystify them. When Counseller X tells the jury in his address that something is law which is not law, the Court quietly corrects the assertion in his charge, and the correction has the weight of authority. The jury believe the judge and discredit Counsellor X. But when Charlatan B tells them something is science that is not science, the true, yet modest A's assertions are no more authoritative to decide the question than B's. The jury must decide, or rather make a guess, as to what is right or wrong; and the average juryman is rather more likely to guess wrong than right in matters of science.

Now there is a plain, simple, and practical remedy for this state of things. In all cases where there are points of law to be decided, there is an arbiter on the bench to perform that office. There should be an equally authoritative tribunal to decide on scientific points, a separate jury of experts, if may be, constituting, for the time, a scientific court, whose charge to the jury should be as authoritative as that of the judge. Would it not be refreshing to hear such a witness as the one mentioned above, who swore to finding aconite, disposed of in the following fashion:—"It is my duty, gentlemen of the jury, as foreman of the scientific jury in this case, to instruct you that aconite cannot be detected by the process described in the testimony of the witness. However much he may be convinced that he did so, it is contrary to known laws of chemistry to suppose that he so obtained it. You are, therefore, to dismiss from your minds the possibility of such a result in your deliberations upon this case." Or perhaps this:

"The process sworn to by A will obtain arsenic from the stomach of a person poisoned by that substance. The process sworn to by B will not obtain it. A says that by his process he found no arsenic. B says he found it in a process by which he could not have found it. It remains for you to judge whether, if by an accurate method arsenic could not be found, the testimony of one who swears he found it by an impossible process proves its presence."

Let such a course be pursued, and we soon should have somewhat less of *pseudo* science on the witness stand, and true scientific testimony would become of real value.—*Scientific American.*

ON THE PRESENCE OF IODATE OF CALCIUM IN SEA-WATER.

By E. SONSTADT.

Having had occasion to study the conditions under which iodides may be oxidised into iodates in the presence of a free or carbonated alkaline or earthy base, my experiments showed that an iodide could not permanently exist in solution under such conditions, and with free exposure to air, without undergoing oxidation into iodate. Hence it was inferred that whatever iodine sea-water contains must be in the state of iodate, since the conditions present in sea-water come within the range of the conditions experimentally ascertained. It was further inferred from

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* *Ann. der Chem. und Pharm.*, vol. clxiii. p. 47.

† *Proc. Roy. Soc.*, vol. xvii., p. 342, § V.

‡ *Ibid.*, p. 341, § III., Matthiessen and Wright.

the results of experiments made upon the iodates, and especially upon iodate of calcium, that iodine must always be set free in sea-water wherever there is putrescent organic matter; and that, while this is being oxidised at the expense of the oxygen in the iodate, the freed iodine slowly re-forms iodate by the decomposition of water conjointly with that of carbonate of calcium. It was ascertained by direct experiment that an iodate can be formed in a liquid in which hydrogen is nascent.

My experiments upon sea-water have been made upon three specimens, drawn respectively from near the Light-Ship on the Bahama bank, about seven miles from Ramsey, Isle of Man; from the bay opposite the small river passing through Ramsey, and taken at about half a mile from the pier; and from the shore, about half-way between Ramsey and Manghold Head. For the first-named specimen I am indebted to the kindness of Captain Temple, of the Light-Ship. This specimen, of sp. gr. 1·02706 at 7°, contained no sensible proportion of free iodine, although I have had it a long while and it has been kept in a wooden cask. The specimen from the Bay had sp. gr. 1·0235 at 11°. It was not perfectly limpid, and, upon shaking up with carbonic disulphide, gave the iodine colouration. The water taken near the shore had sp. gr. 1·02636 at 11°, and when fresh, gave no iodine reaction when shaken up with carbonic disulphide, and contained all its appreciable iodine, as did the water from the Light-Ship, in the state of iodate. But after a few days its condition changed; it contained free iodine, and retained scarcely a trace of iodate.

The experiments now to be described relate to the sea-water taken near the Light-Ship, and to the specimen of water from near the shore in its fresh state. Sulphuretted hydrogen passed through such water causes considerable opalescence from deposited sulphur (much more than can be ascribed to the nitrates present), especially after warming, and an iodide is then contained in the water. Many other reducing agents may be used, and especially ferrous sulphate or sulphite of sodium. The reaction with ferrous sulphate is remarkable. If a minute crystal of this salt is dropped upon the surface of the sea-water so that it may float, and the test-tube or beaker is held in a suitable light, white clouds of ferrous iodate may be seen to form in the train of the solution descending from the crystal. If too large a crystal is taken, the effect is marred or lost, as a very slight excess of ferrous salt makes a clear solution. A precisely similar reaction may be obtained between the ferrous salt and an excessively dilute solution of iodate of calcium. The colour of the precipitate soon changes to brown. To obtain an iodine reaction from the sea-water, it is sufficient to add a minute proportion of ferrous sulphate, some dilute sulphuric acid, and a drop or two of carbonic disulphide. After a while, and from a quantity of water of about 50 to 100 c.c., a recognisable iodine colouration is obtained. If too much ferrous salt is used, the reaction is very evanescent; but it may be restored, though not quite perfectly, by cautious addition of a few drops of dilute chlorine water. Sulphurous acid, not in excess, may be used in place of ferrous sulphate in this experiment. If the sea-water is in good condition, it may be concentrated without loss of iodine or decomposition of the iodate of calcium, which, however, separates with the other calcium salts in great part, so that beyond a certain point the proportion of iodate in the liquid does not increase with further concentration. The quantitative estimation of the iodine in sea-water is difficult, owing to the exceedingly small proportion in which it is present, and the number of elements of which the action must be taken into account. It is easy to transform the iodate into iodide; but, to do this, and evaporate to dryness and exhaust with alcohol, is useless as a quantitative method, owing to the more or less sparingly soluble salts which iodine forms with silver, rubidium, and cæsium—all recognised as being present in sea-water. Thallium, also, forms an iodide belonging to the same class; and, although I have not seen this mentioned as contained in sea-water, it must be there, since I have found it in the ash of sea-weed. Even iodide of sodium is but sparingly soluble in alcohol. The method of exhaustion by alcohol is therefore not available. With the view to overcome this difficulty, I experimented upon the relative solubilities of the halogen salts of silver in pure, strong hydrochloric acid. It was found that pure iodide of silver requires 150,000 parts of *hot* hydrochloric acid to dissolve it, and that from this solution it crystallises on cooling. The solubility of chloride of silver appears to vary according to the condition it is in; but in no case was it found to require more than about 2000 parts of cold hydrochloric acid for solution; and, in one instance, 1 part of the chloride was obtained in solution in 342 parts of *hot* acid, the solution crystallising on cooling. The solubility of bromide of silver is less than that of the chloride; but, relatively to the iodide, the bromide and chloride of silver may be classed together. I found, further, that while the addition of sulphurous acid to hydrochloric acid greatly increases its action upon chloride and bromide of silver, it has little, if any, effect in increasing the solubility of iodide of silver. The addition of nitric acid, or, what amounts to the same, of chlorine, enables the acid to dissolve the iodide pretty freely. Ferrous sulphate added to the acid produces a like result.

The application of the facts above stated to the quantitative estimation of the iodine in sea-water I reserve for a future communication, confining myself here to a statement of the manner in which I have applied them to the qualitative proof of the presence of iodine, by way of confirmation of the results obtained by the other methods indicated. One or two hundred cubic centimetres of the water to be examined are shaken up with a few drops of solution of slightly alkaline sulphite of sodium, prepared from pure sulphurous acid, and hydrate of sodium made from the metal. After some time, two or three cubic centimetres of saturated solution of acetate of silver are added, and then about a fourth of the volume of the liquid of strong hydrochloric acid free from chlorine. The liquid is left at rest for a few hours, then filtered, the filter washed with dilute hydrochloric acid, and lastly with a little water. The filter is then moistened with a strong solution of pure hydrate of sodium, and heated in a covered crucible to low redness for a few minutes. After cooling, water is added, the solution filtered, and the filtrate, strongly acidulated with dilute sulphuric acid, is shaken up with carbonic disulphide and sufficient very dilute chlorine water to develop the sodium reaction. By proceeding in this way, a fine colouration is obtained from about 200 c.c. of the water.

A soluble sulphide or sulphuretted hydrogen cannot exist in presence of an iodate. But sea-water overcharged with effete matter, as before the mouth of a river conveying sewage from a town, such as was the specimen of water taken opposite the mouth of the river at Ramsey, does, on prolonged boiling, give off sulphuretted hydrogen, although it contains no trace of a sulphide before heating, as was proved, in the case referred to, by the total absence of colouration on addition of acetate of lead to the water.

So far as my experiments go, I find that it is only *putrescible* organic matter that is decomposed by and decomposes iodate of calcium. My experiments also indicate that this substance (the iodate) possesses, in a high degree, the power of preventing fungoid growths in very putrescible liquids. The alkaline iodates behave in this, and in other respects, differently to the iodate of calcium.

My principal object in conducting the investigation, of which this note gives a preliminary account, is to subject to rigorous experimental tests a theory respecting the function of the iodate of calcium in the sea; to which, notwithstanding the extremely small proportion in which it exists, I attribute the property of maintaining, owing to its condition of unstable equilibrium, and thereby its action on putrescible matter, not only the salubrity of the sea, and, through the medium of the atmosphere, of the land

also; but also that of furnishing the ammonia required **by the** *Fuci*, by the presentation of nascent hydrogen **derived** from the decomposition of water, to the nitrogen liberated during the oxidation of dead organic matter. If I am right in my view, the activity of this agent is necessarily exactly in proportion to the need for its activity—being adjusted thereby—the work being done at the expense of the decomposition of water.

I trust before long to communicate the details and results of further experiments, especially with reference to the quantitative determination of the iodine in sea-water; and to the properties of iodate of calcium, and the relation of these properties to the place it occupies in Nature's grand system of hygiene.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 18th, 1872.

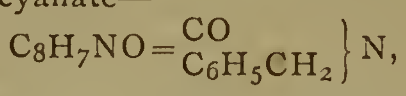
Dr. Frankland, F.R.S., President, in the Chair.

The President announced from the chair the presence of Professor Himly, of Kiel, and of Professor Eschenburg, as visitors.

After the minutes of the preceding meeting had been read and confirmed, Messrs. R. W. Atkinson, George Attwood, and William H. Walbourn were formally admitted Fellows of the Society.

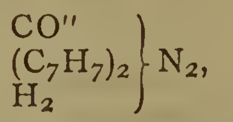
The donations were then announced, and the following names read for the first time:—Messrs. C. H. W. Biggs, John Grove Johnson, Joseph Arderne Ormered, B.A., and Ernest Henry Jacob, B.A. For the third time—Messrs. Thomas Tyrer, Frederick William Fison, B.A., George Blundell Longstaff, B.A., John Robins, Thomas Robertson Ogilvie, Mark Finch, and Arthur John Dickinson; these gentlemen were then ballotted for and duly elected Fellows of the Society.

The Secretary then read a paper "*On Benzyl Isocyanate and Cyanurate*," by E. A. Letts, in which the author, after noticing the ethylic and methylic isocyanates and isocyanurates discovered by Wurtz, the corresponding phenyl compounds, and the so-called phenyl isodicyanate, remarks that in the toluol group eight possible compounds may exist, of which only three have as yet been obtained, viz., toluyl isocyanate and isocyanurate by Hofmann, and benzyl cyanurate by Canizzaro. On distilling a mixture of silver cyanate and benzyl chloride in a paraffin-bath, benzyl isocyanate comes over mixed with benzyl chloride, and ultimately, on raising the temperature, benzyl cyanurate. The isocyanate—



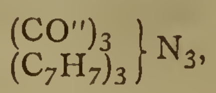
$$C_8H_7NO = \left.\begin{matrix}CO\\C_6H_5CH_2\end{matrix}\right\}N,$$

is a colourless liquid having a pungent odour, which, although it cannot itself be obtained pure enough for analysis, yields several derivatives capable of purification. *Monobenzyl urea*, $C_8H_{10}N_2O$, obtained by the action of alcoholic ammonia on the impure benzyl isocyanate, crystallises in long white needles, which are almost insoluble in cold water, but readily soluble in alcohol; it melts at 144°. *Dibenzyl urea*—



$$\left.\begin{matrix}CO''\\(C_7H_7)_2\\H_2\end{matrix}\right\}N_2,$$

formed by heating the isocyanate with water, melts at 167°, and closely resembles the monobenzyl compound in appearance and properties. Phenyl-benzyl urea, $C_{14}H_{14}N_2O$, was also prepared. The benzyl isocyanurate—



$$\left.\begin{matrix}(CO'')_3\\(C_7H_7)_3\end{matrix}\right\}N_3,$$

mentioned above, crystallises from its solution in hot alcohol in long slender needles, which melt at 157°, and when fused with potassium hydrate, yield benzylamine, $C_7H_7.H_2N$. From the close resemblance in properties between the isocyanurate just described, and the benzyl cyanurate discovered by Canizzaro, the author thinks it probable that they may be identical.

A second paper by the same author, "*On a Compound of Sodium and Glycerine*," was then read. Since glycerine is a triatomic alcohol, three sodium compounds of this body should exist, in which 1, 2, and 3 of the hydrogen respectively are replaced by the metal. By the action of sodium amalgam on glycerine and subsequent treatment with alcohol, or better, by dissolving sodium in alcohol and adding glycerine, a solid compound is obtained, insoluble in alcohol and exceedingly deliquescent. When dried between filter-paper, it has the composition $C_3H_5.NaO.HO.HO+C_2H_5.HO$, but loses the combined alcohol when heated to 100° in a current of hydrogen, leaving mono-sodium glycerine, $C_3H_7NaO_3$, as a white amorphous powder. The latter is decomposed by water into glycerine and sodium hydrate, and, when heated, yields acrolein.

Dr. Hofmann said that the production of benzyl isocyanate formed a very interesting and striking lecture experiment. It was very important to show the different position of the chlorine in the isomeric chlorine substitution compounds of the aromatic series: for instance, two isomerides were obtained from toluol by the action of chlorine; that in the cold being chloro-toluol, in which the chlorine entered into the benzene; whilst at a high temperature, benzyl chloride was formed, in which the chlorine was in the methyl. If small quantities of each of these chlorides were taken, and dry silver cyanate added to them, the toluol chloride was quite unacted on, whilst the benzyl chloride was decomposed with explosive violence; and even if they were not fortunate enough to see the experiment, they would be able to smell it, the pungent isocyanate vapour producing powerful lachrymation. In answer to a remark of the President, Dr. Hofmann said he had some new and interesting compounds to exhibit, which he would like to illustrate by a few experiments, but as these would leave a bad odour behind them, he must ask to be permitted to defer them until the close of the sitting.

"*On the Determination of Carbonic Acid in Sea-Water*," by Professor Himly. The author, who delivered his address in German, after noticing the difficulties which beset the determination of carbonic acid in sea-water—Jacobsen having shown that the whole of the gas present is not given off by boiling either *in vacuo* or under the ordinary pressure at 100°, even when a current of air is passed through the liquid—said, however, that the whole of the carbonic acid could be readily estimated by adding baryta-water or barium nitrate, ammonium nitrate, and ammonia to a measured quantity of the sea-water, thus obtaining the whole of the carbonic acid in the precipitate. After the supernatant liquid had been removed, the carbonic acid might be estimated in the precipitate. In order to collect sea-water for the determination of the carbonic acid at great depths, and consequently under great pressures, it was necessary to sink a cylinder open at both ends to the place where the water was to be collected, and then to securely close it there. The apparatus for that purpose, closed by valves, had been found to be very defective; but he had employed one which answered admirably, consisting of a cylinder furnished with a large stopcock at each end. When this cylinder had been sunk to the required depth, the stop-cocks were closed by powerful springs released at the proper moment by means of an electro-magnet set in action in the usual way.

The President said that the problem of the determination of the carbonic acid in sea-water was at the present time of peculiar interest, as an expedition was being fitted out to sail round the world, and one of its objects was to collect sea-water at various depths, and either to make determinations of the gas contained in it on board ship, or to bring it home for that purpose. Dr. Carpenter deemed it of the greatest physiological importance to determine the amount of carbonic acid in the water; and since the ordinary method failed to eliminate the whole of the carbonic acid—Professor Himly having mentioned that but little of that gas is evolved until the water is evaporated to about one-half, when it comes off somewhat suddenly—its conversion into baric carbonate would allow of the determination being made in a quiet sea, or of being brought home for that purpose.

In reply to a question by the President, Professor McLeod remarked that with fresh water he had never observed the sudden evolution of carbonic acid described. All the dissolved carbonic acid was given off *in vacuo* at 50°, although to eliminate the whole of the combined carbonic acid it was necessary to evaporate to dryness *in vacuo*. He had only made two experiments with sea-water, and those with a sample which had been collected some years previously.

Professor Himly said that when sea-water was distilled, the magnesium chloride present was decomposed, hydrochloric acid passing off, and the magnesium remaining behind combined with a portion of the carbonic acid. At the request of the President, he also explained the manner in which the apparatus for collecting sea-water at great depths was closed.

Two short papers by Dr. T. E. Thorpe were then read by the Secretary; the first being "*On the Action of Phosphorus Pentasulphide on Tetrachloride of Carbon*," from which it would appear that the pentasulphide has no action on tetrachloride of carbon, even when heated with it to 200° for a week. The second was "*On the Degree of Solubility of Silver Chloride in Strong Nitric Acid*." The author submitted silver chloride prepared with great care to the action of strong nitric acid, which had been purified as far as possible, and found that 100,000 parts of the acid dissolved about 2 parts of silver chloride, the presence of lower oxides of nitrogen in the acid not sensibly affecting the result. When, however, the silver chloride had become blackened by exposure to light, it was less soluble in the acid, 100,000 parts dissolving only 0·8 parts of the blackened chloride.

Mr. Spiller said that, from an experiment he had made in which silver chloride was exposed under water to the action of light for some years, he believed it was decomposed, and that this might even proceed so far as to leave the metal; darkened silver chloride would therefore consist of unaltered silver chloride mixed with more or less metallic silver.

Dr. Hofmann said he would like to avail himself of the opportunity he enjoyed of being once more at the Chemical Society, to exhibit to the Fellows some interesting compounds he had lately been working with. About ten years ago, he had examined the ethylic derivatives of phosphuretted hydrogen, and, in order to obtain them, had acted with phosphorus trichloride on the zinc-ethyl discovered by the President; this, however, only yielded the tertiary compound, and although he had often felt a desire to obtain the primary and secondary members of the series, his endeavours were in vain. Nearly every year since that time he had made experiments with this object, for if the lower members could be prepared we might expect to obtain from them many compounds, such as the isocyanates and mustard oils, which the tertiary, from its great stability, does not yield. A lecture experiment, however, indicated the method by which during last summer he had succeeded in preparing a considerable quantity of these lower phosphines. He was desirous of exhibiting the decomposition of phosphuretted hydrogen by the electric spark in the same manner as ammonia, but found that the gas prepared by the ordinary methods was always impure, containing as much as 60 to 80 per cent of hydrogen. The action of water on iodide of phosphonium, PH_4I, however, which can be prepared by Baeyer's method in any quantity, yielded phosphuretted hydrogen in a state of absolute purity. By placing the iodide in a small flask, and allowing water or potash solution to drop on it, any desired quantity of phosphuretted hydrogen may be obtained; and on introducing this into the eudiometer, and passing the spark current for less than five minutes, phosphorus is deposited on the sides of the tube, the two volumes of PH_3 leaving three volumes of hydrogen. This forms a magnificent lecture experiment. It will be seen that the iodide of phosphonium furnishes us the means of generating pure phosphuretted hydrogen, even under pressure, so that methylic or ethylic iodide can be conveniently submitted to its action in the same manner as, many years ago, ethylamine was prepared from ammonia by the action of ethylic iodide. A large tube was therefore partly filled with iodide of phosphonium, and zinc oxide rammed down on the top of it, so as to allow sufficient time to close the tube before the ethylic iodide, which was now introduced, could penetrate to the phosphorus compound. On agitating the tube and mixing the contents, a reaction took place with methylic iodide even at the ordinary temperature, although it was better to heat to 100°. Ethylic iodide required 120°, and higher temperatures were employed for the higher members of the series. It was found that the action of ethylic iodide on iodide of phosphonium in the presence of zinc oxide or water produced the two substances, ethyl and diethyl phosphine, which had been so long sought for without any admixture of the higher compounds. As there was but a comparatively small quantity of the substance in the first instance, considerable difficulty was anticipated in separating them, but it was found that these compounds, so to say, separated themselves. The iodide of ethyl-phosphonium, EH_3NI, has so much the character of the iodide of phosphonium, that, on allowing a stream of water to flow into the mixture, it was at once decomposed, giving off the monethyl-phosphine in a state of absolute purity, whilst the secondary compound was unacted on. After distilling off all the EH_2P, the addition of potash liberated the diethyl-phosphine, and that could likewise at once be obtained in a state of purity. Even if they had been less easily separated, the considerable quantities afterwards operated on would no doubt have ultimately enabled them to be separated, as in this research some 6 or 8 kilogrms. of iodide of phosphonium had passed through the speaker's hands. The question naturally suggested itself whether the hydriodic acid in the iodide of phosphonium could not be made to furnish the ethylic iodide for the conversion of the phosphuretted hydrogen into phosphorus bases. On treating the iodide with absolute alcohol to 100°, an action takes place, but, strange to say, only the tertiary and quarternary compounds are produced, the same as those obtained from zinc ethyl by phosphorus trichloride.

Dr. Hofmann then experimentally exhibited the formation of phosphuretted hydrogen by the action of water on iodide of phosphonium, and the decomposition of iodide of ethyl-phosphonium by water, liberating the ethyl-phosphine, EH_2N, which has the characteristic odour of the phosphorus bases. He also explained Baeyer's method of preparing iodide of phosphonium on the large scale by the action of water on iodide of phosphorus, stating that it was necessary to employ a very large excess of phosphorus, three or four times the theoretical, since much of it is converted into the amorphous state, and thereby rendered inactive.

The President, in thanking Dr. Hofmann, said that these interesting compounds, obtained as they were so readily in a state of absolute purity, would form starting-points for new researches, for the results of which they should anxiously look forward.

The meeting then adjourned until Thursday, the 2nd of May, when Mr. E. Riley will deliver a lecture "On the Manufacture of Iron and Steel."

ROYAL IRISH ACADEMY.

At a meeting of this Society held on Monday, April 8th, Mr. G. J. Stoney, F.R.S., read a most valuable and interesting paper "*On the Constitution of the Outer Atmosphere of the Sun.*" The principal objects of this paper were to point out that certain theoretical speculations of the author, published on the Physical Constitution of the Sun and Stars (*Proc. Roy. Soc.*, vol. xvii., p. 1, and other journals), had been verified by spectroscopic observations of the sun during eclipse, and also to account for certain unknown lines. The constituents of the solar atmosphere will range to heights which stand in the order of the masses of their molecules. If, for example, an atmosphere of uncombined nitrogen and hydrogen, the boundary of each gas will be at a different height; where the nitrogen is no longer able to maintain itself, the molecule of hydrogen, with a velocity $\sqrt{14}$ (or nearly 4) times as great, can still spread far beyond it (the lecturer was speaking from the point of view which holds to the dynamical theory of the molecular constitution of gases), although the nitrogen will reach a greater height in consequence of the presence of the hydrogen than it could alone.

The following were some of the coronal and other lines observed, the wave-length being the number in a millimetre measure *in vacuo* :—

		Hydrogen.		Lithium.
	C	1523·47	Li_1	1490·92
	F	2056·72	Li_2	1638·29
	G	2303·44	Li_3	2010·70
	h	2437·62	Li_4	2171·98
	H	1416·00 (?)	Chromospheric lines of hitherto unknown origin.	
Coronal line.	D_3	1702·80		
	Y	1880·60		
	Z	2235·80		

Calcium, chromium, manganese, iron, nickel, cobalt, copper, zinc, and barium lines are found in the photosphere, but only such atoms as sodium and magnesium could rise to coronal heights. Mr. Stoney believes the line D_3 to be a fourth hydrogen line, and that the other chromospheric lines are due to lithium.

There was also a paper read, contributed by F. Webber, "*On the Floatation of Sand on the Surface of the River Ganges.*"

ROYAL GEOLOGICAL SOCIETY OF IRELAND.

At the meeting held on Wednesday, the 10th inst., Mr. Westropp gave a "*Sketch of the Physical Geology of North-West Clare*" and Mr. Edward Hull, F.R.S., read a paper entitled "*Remarks on the Report of the Royal Commission on the Coal Resources of Great Britain and Ireland.*"

Specimens of xanthophyllite, a rare Russian mineral, were exhibited by Dr. Frazer.

NOTICES OF BOOKS.

Index of Spectra. By William Marshall Watts, D.Sc., Senior Physical Science Master in the Manchester Grammar School. With a Preface by H. E. Roscoe, B.A., Ph.D., F.R.S., Professor of Chemistry in Owen's College, Manchester. London: Henry Gillman. 1872.

All workers with the spectroscope will agree with Dr. Roscoe in the inconvenience arising from the employment of different scales in the mapping of spectra; and they will welcome Dr. Watts's endeavour to facilitate spectroscopic research by collecting all existing measurements of the spectra of the elements, and presenting them on a uniform scale of wave-lengths. Dr. Watts has adopted as the basis of his work Angström's measurements of the wave-lengths of the principal Fraünhofer lines, the most accurate obtainable. These measurements are so very exact that it is unlikely that any corrections which may be rendered necessary by new and more exact measurements will affect them, except in the decimal place. The spectral lines are calculated to the ten-millionth part of a millimetre throughout. But Dr. Watts besides has collected the numbers obtained by Fraünhofer, Ditscheiner, Van de Willigen, Bernard, Mascart, and Esselbach, as well as the mappings of most of the spectra of the elements by Huggins, Thalén, and Kirchhoff. In the case of the elements whose spectra have not been examined by Thalén, Huggins, or Kirchhoff, the most accurate results have been given, with references to the original memoirs. The numbers given from Mascart, Ketteler, and Müller were obtained by direct observation of the diffraction spectra; while Plücker's measurements for chlorine, bromine, iodine, phosphorus, sulphur, selenium, nitrogen, and oxygen have been reduced to wave-lengths by means of an interpolation-curve drawn from the lines of oxygen and nitrogen. Twenty-eight of the measurements of the spectra of the elements are checked by comparison with Dr. Gibbs's results. Chromo-lithographs of the double spectra of nitrogen, sulphur, and carbon are given. The intensities of the various lines are clearly compared; and, indeed, all has been done that will in any way assist the spectroscopist. The work will be found equally as useful with instruments of only one or two prisms as with the largest spectroscopes. We commend it to the notice of our readers.

CORRESPONDENCE.

ESTIMATION OF NITROGEN IN NITRATES.

To the Editor of the Chemical News.

Sir,—I read with much interest, Mr. John Ruffle's paper on "The Estimation of Nitrogen in Nitrates by Combustion" in the Chemical News (vol. xxv., p. 189), but was disappointed to find that, though we are informed that the estimation is conducted by a modification of the usual process, we are left entirely in the dark as to what the *modus operandi* really is.

Perhaps Mr. Ruffle will favour us with more details, which, I am certain will prove useful to chemists as yet beyond the pale.—I am, &c.,

Rowland J. Atcherley.

39, British Street, Bow, E.
April 22, 1872.

ORIGINAL RESEARCH.

To the Editor of the Chemical News.

Sir,—Permit me to offer a few remarks on the subject of the letter of your correspondent "A. T." concerning the want of recognition of original research.

A. T. very truly says that help from Universities in this matter is not looked for; for the obvious reason that the case is beyond their province. Before a man can be qualified to become a trustworthy experimentalist, a large amount of preparation and study, theoretical and practical, is indispensable; a thorough knowledge of the results obtained by previous workers is requisite, and a liberal education, not only in the particular branches of science to which he intends to devote himself, but also in other departments, is, if not absolutely necessary, at the least extremely desirable. A University can do no more than guarantee that a man has conscientiously gone through this amount of *preparatory* training; *apropos*, it may be doubted if the recognition obtained by passing an examination which merely requires that the candidate shall, by dint of *coach* or *cram*, manage to partially answer some of a series of questions, is of any real help in the struggle for existence.

A man who, after acquiring a thoroughly solid scientific education, devotes himself to original research, has at present for sole recompense the pleasure he experiences in his labours of love, and the reputation he acquires through his work among those who are qualified to judge it; popular recognition is out of the question, because the majority are not sufficiently educated to understand the high character of this labour: another man who, after a long course of study of books, men, and things, devotes himself to literature or to art has, in addition to these incentives, the pecuniary recompense arising from the sale of his productions, books, pictures, sculpture, &c. Is the work of the scientific inquirer into nature of less value to the commonwealth than that of the literary man or of the artist? Such modern *necessaries* of civilisation as gas, telegraphs, railways, printing, dyeing materials, glass, &c., would not have existed but for the work of the former; even commerce could scarcely have existed, as ocean navigation would be impracticable but for the discoveries of scientific men. Although in certain cases it might be difficult to say at once what *direct* benefit to the community would ultimately accrue from the prosecution of a research, yet it is evident from innumerable examples that *anything that adds to the knowledge really adds to the wealth of the community*.

Why could not a system of national, or even international, prizes and rewards for scientific research be instituted? True the requisite funds would ultimately come out of the pockets of the non-scientific part of the community; but does not the pecuniary reward of the literary man or of the artist ultimately come out of their pockets too? The purchaser of a book, picture, statue, &c., acquires the means of making the purchase by charging a higher price for the professional labour that he performs for others, for the goods he sells, for the houses or land that he lets, and so on; in the long run, the community at large bears the expense of the pecuniary rewards of literary men and artists, and profits in many ways by so doing. It can scarcely be doubted that great ultimate profit would also accrue if the labours of scientific men were also recompensed by the community; inasmuch as far more work of this kind would be done then than is now, and a corresponding increase of knowledge, *i.e.* wealth, would result.—I am, &c.,

Graduate.

London, April 23, 1872.

MISCELLANEOUS.

Complimentary Dinner to Dr. Moffat.—Dr. Moffat was entertained to dinner in the Tontine Hotel, Glasgow, on the 13th inst., by several of his students, in token of their high esteem of him as a teacher of chemistry. An excellent dinner having been partaken of, Dr. Cameron was called to the chair, who, after making a few appropriate remarks befitting the occasion, thanked Dr. Moffat, in the name of the students, for the kindness and courtesy shown to them by him. Several songs and recitations having been given, the party broke up, after a most agreeable meeting, each student bearing away with him a grateful remembrance of the kindness and abilities of his worthy teacher.

Quality of the Metropolitan Gas.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently submitted to the Corporation of London and the Metropolitan Board of Works his quarterly report of the quality of the gas supplied to London, by the Chartered, the Imperial, and the South Metropolitan Gas Companies from which it appears that the average illuminating power of the Chartered gas has been equal to that of 17·10 standard sperm candles at Beckton, 17·64 candles at Cannon Street, 17·92 at Friendly Place, 17·12 at Arundel Street, and 16·62 at Millbank Street. That of the Imperial gas has been 16·57 candles at Oakley Square, 16·02 at Camden Street, and 16·22 at Graham Street; that of the South Metropolitan having been equal to 15·82 candles. The Cannel gas of the Chartered Company has averaged 24·55 candles at Arundel Street, and 24·85 candles at Millbank Street. As regards purity, Dr. Letheby reports that the gas of all the companies has been constantly free from sulphuretted hydrogen, excepting that of the Chartered Company at Millbank Street, where it was twice found to be charged with this impurity. He reports, however, that this was caused by accidental circumstances over which the company had no control. The amounts of sulphur in other form than this have ranged from an average of 22·67 grs. in 100 cubic feet of the Chartered gas at Friendly Place to 42·59 grs. at Beckton—the proportions at each of the testing places having been as follows:—the Chartered gas at Cannon Street, 34·68 grs. per 100 feet; at Arundel Street, 35·52 grs.; at Beckton, 42·59; at Millbank Street, 27·58; and at Friendly Place, 22·67. That of the Imperial Company contained 37·03 grs. per 100 feet at Oakley Square, 25·56 at Camden Street, and 28·23 at Graham Street; and the gas of the South Metropolitan Company contained 31·27 grs. The proportions of sulphur in the Cannel gas of the Chartered Company were 23·01 grs. per 100 feet at Arundel Street and 26·59 grs. at Millbank Street. Dr. Letheby draws attention to the fact that the common gas at Friendly Place contained only 19·87 grs. of sulphur as the average amount during the whole of last year, and that there were 162 occasions when it contained less than 20 grs. per 100 feet, whereas, during the present quarter, the quantity of sulphur in the Beckton gas has averaged as much as 42·59 grs. He says, also, that the amount of sulphur in the Cannel gas at Cannon Street was only 11·20 grs. per 100 cubic feet in 1871, and that there were 225 occasions when it was under 20 grs., whereas in the present quarter it has amounted to an average of 23·01 grs. at Millbank St, and 26·5 grs. at Arundel Street. These facts show that the processes of purification and manufacture are not so perfect as they were in 1871. The quantity of ammonia in the gas has not been excessive, for it has ranged from 0·0 to an average of 0·6 of a grain in the gas at various places.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 1, 1872.

This number opens with an essay—

Theory of the Cause of the Aurora Borealis.—M. de la Rive.

This number also contains, in addition to several important papers relating to astronomy, meteorology, and natural history, the following papers and memoirs more particularly relating to chemistry:—

Second Instalment of a Memoir on the History of Fermentation.—Prof. E. Chevreul.—This portion of the excellent memoir is divided into the following chapters:—Stahl; analogy and difference existing generally between the ideas of Stahl and van Helmont; the chemical books edited by Stahl reviewed in their general bearing; Stahl's fermentation theory; Stahl's theory of combustion. The general conclusion to be drawn from these chapters is that the theories of Stahl on fermentation and combustion bear rather a *physical* than a *chemical* character.

Rinderpest.—Dr. Bouley.—The author, representative member for France at the international conference now holding its sittings at Vienna for the purpose of considering the means to be adopted for preventing the rinderpest (a disease originally endemic to the Steppes country of Russia) from being propagated, states, in a short note to Dr. Thenard, that practically this question has been settled. Particulars as regards the method are not communicated as yet.

Theoretical Considerations on the Thermometrical Scales of Temperature and on the Co-Efficient of Dilatation of the Permanent Gases.—Dr. Crova.—In consequence of a very severe critical attack made by Dr. Mohr (in his work "Mechanischen Theorie der Chemischen Affinität;" Bonn, 1868) upon the centigrade thermometer scale, which he (Dr. Mohr) considers to be as imperfect and arbitrarily made up as the scales of Cartier's and other areometers, and particularly to be suffering from the defect that for a given number of degrees the increase of temperature should not be the same, the author of this memoir (here only briefly mentioned in very short abstract, the original being published in the *Mémoires de l'Académie des Sciences et Lettres de Montpellier*) has investigated this subject, and points out the errors made by Dr. Mohr.

Spontaneous Motion of Liquids in Capillary Tubes.—C. Decharme.—A treatise on capillarity.

On Sorbite, a Saccharine Matter Analogous to Mannite, Met with in the Berries of the Sorbus Aucuparia.—J. Boussingault.—The introduction of this memoir is devoted to the communication of researches made by the author on the subject of the difference in quantity of alcohol obtained by distillers on the large scale as compared with the quantity which theoretically should be obtained. It appears that in some parts of the Continent the berries of the *Sorbus Aucuparia* (sorb-tree) are bruised and the juice fermented, yielding a kind of wine, in which the author has discovered the presence of sorbite, a sweet-tasted material, nearly insoluble in cold absolute alcohol, but soluble in that liquid when boiling. Sorbite may be obtained in the shape of crystals, which contain water of crystallisation and have the formula $C_{12}H_{15}O_{13}$, but when dried at 110° the formula is $C_{12}H_{14}O_{12}$; fusion-point, 65°.

Some Metallic Trichloracetates.—A. Clermont.—The author describes at considerable length the following salts of trichloracetic acid:—Of potassa, $KO,C_4Cl_3,HO,C_4Cl_3O_3$, a beautifully crystalline substance, unalterable in air; gives off, when heated, abundant fumes of trichloracetic acid; it contains in 100 parts—Potassa, 12·90; carbon, 13·14; hydrogen, 0·27; chlorine, 58·34; oxygen, 15·35. Of oxide of nickel, $C_4Cl_3O_3,NiO,+4HO$; in 100 parts—Oxide of nickel, 16·44; trichloracetic acid, 67·76; water, 15·80. Of magnesia, $C_4Cl_3O_3,MgO,+4HO$; in 100 parts—Magnesia, 9·50; trichloracetic acid, 73·39; water, 17·11. Of lithia, $C_4Cl_3O_3,LiO,+4HO$; in 100 parts—Lithia, 7·29; trichloracetic acid, 75·18; water, 17·53. All these salts are crystalline, but the two last-named are very deliquescent.

Identity of Bromhydrate and Iodhydrate of Bromated Propylen with the Dibromhydrate and Iodobromhydrate of Allylen. Dibromhydrate of Acetylen.—E. Reboul.—Notwithstanding the very high scientific merits of this lengthy essay, its contents do not admit of any useful abstraction.

Annalen der Chemie und Pharmacie (double number), February and March, 1872.

This number contains the following original papers and memoirs:—

Methyl-Mercaptan-Trisulphonic Acid, Methyl-Mercaptan-Disulphonic Acid, and Methyl-Alcohol-Trisulphonic Acid.—M. Albrecht.—The contents of this lengthy monograph treat on the action of sulphite of potassa upon perchlor-methyl-mercaptan, $CSCl_4$, and the products of conversion of this reaction. We regret that, notwithstanding the high scientific value of this essay, it is not suited for useful abstraction, but we quote the headings of the different sections—Methyl-mercaptan-trisulphonic acid; origin of methyl-mercaptan-disulphonic acid from methyl-mercaptan-trisulphonate of lead; origin of the last-named acid from methyl-mercaptan-trisulphonate of silver; methyl-alcohol-trisulphonic acid and its salts; action of neutral sulphite of potassa upon sulpho-carbonyl chloride and upon sulphide of carbon.

Action of Sulphite of Potassa upon Bodies Containing CCl_3.—B. Rathke.—The leading idea of the researches here published at great length has been to ascertain whether a fixed rule could be found, according to which the Cl in the complex atom CCl_3 is entirely exchanged for SO_3K, or in part for H. The bodies investigated in this direction are—Trichlor-formen-sulphon chloride, $CCl_3.SO_2Cl$, and the potassa salt of this acid; chlor-picrin, $CCl_3.NO_2$; chloral hydrate, $CCl_3.COH+H_2O$; and trichloracetic acid, $CCl_3.CO_2H$. There is added to this lengthy essay a review, elucidated with a series of formulæ, exhibiting the results of the action of sulphite of potassa upon the group of bodies containing CCl_3.

Some Instances of the Formation of Chemical Compounds with Deficient Affinity.—B. Rathke.

Formation of the Fatty Alcohols from their Initial Atoms (Anfangsgliedern); Part 13—Synthesis of Normal Butyric Acid.—E. Linnemann and V. von Zotta.—The continuation of a lengthy and exhaustive monograph on this subject, Part 14 treating on the synthesis of normal butylic alcohol, and Part 15 on the pure normal butyl derivatives. To be continued.

Some of the Derivatives of Butyron.—Dr. C. M. Kurtz.—This memoir is divided into the following sections:—Action of dichromate of potassa and sulphuric acid upon butyron; action of nitric acid upon butyron; action of nascent hydrogen upon butyron; butyron-pinakon; action of chlorine and chloride of phosphorus upon butyron.

On Allyl-Sulphonic Acid and some of its Salts.—Dr. A. von Rad.—By a circuitous and rather tedious method, the author prepared, first, a double salt of allyl-sulphonate of potassa and iodide of potassium—

$$C_9H_5K_5S_3O_9I_2=3\left\{\begin{matrix}C_3H_5\\SO_2K\end{matrix}\right\}O+2KI,$$

and next converted it, by means of treating it with sulphuric acid, into allyl-sulphonate of potassa—

$$\left.\begin{matrix}C_3H_5\\SO_2K\end{matrix}\right\}O;$$

a baryta and a lead salt were also obtained, likewise a small quantity of free allyl-sulphonic acid, but not in a condition suited for further investigation.

Chemical Constituents of the Leaves of the Ampelopsis Hederacea, Wild Vine.—Dr. E. von Gorup-Besanez.—The leaves of this plant, gathered in June and in September last year, were investigated, and found to contain large quantities of free tartaric acid, bitartrate of potassa, tartrate of lime, gum, fermentable sugar, and a substance which became green-coloured with chloride of iron; while the ash was found to contain percentically the following substances:—Potassa, 24·62; soda, 1·74; chloride of sodium, 2·03; lime, 34·37; magnesia, 8·36; phosphate of peroxide of iron, 7·99; phosphoric acid, 5·84; sulphuric acid, 4·59; silica, 10·46. In September the leaves were found not to contain any bitartrate of potassa, but tartrate of lime was present, and also pyrocatechin.

Reaction for Ozone as Exhibited by the Air in the Neighbourhood of Gradation Machines of Salt-Works.—Dr. E. von Gorup-Besanez.—In the first place, we meet in this excellent essay with a well-digested review on the reagents for ozone, on the detection of ozone in air, and on the presence of nitrous acid in air, and of nitrate of ammonia in rain-water. Next, this memoir contains the detailed account of a series of experiments made with the view to elucidate the phenomenon alluded to, as observed at Kissingen close to the gradation machines of the salt-works situated in that locality. The result come to is that ozone is decidedly present in rather large quantity in the proximity of the works alluded to, though less than the quantity frequently present in the air on the sea-coast, or in the air some few miles distant from land at sea.

Normal Paraffins.—Dr. C. Schorlemmer.—Notwithstanding the high scientific value of this paper, its contents are not suited for abstraction.

On Anti-Combustion Substances.—A. Patera.—The introduction of this paper records a series of dreadful accidents and loss of life, occasioned by the ignition of the inflammable fabrics used as ladies' wearing-apparel. The author next reviews the various substances which have been proposed to be added to the starch or dressing used in making up the readily inflammable fabrics, so as to prevent, if not altogether the combustion of the same when taking fire, the fabrics bursting into flame. While highly approving of the use of tungstate of soda, the author yet thinks there may be substituted for it a cheaper material, viz., a mixture of 4 parts of borax and 3 parts of sulphate of magnesia; these salts are mixed together just before being required (otherwise insoluble borate of magnesia is formed too early), and then dissolved in from 20 to 30 parts of warm water, in which the fabrics are to be immersed, next wrung out, and then dried. A mixture of sulphate of ammonia and gypsum may be used for coarse fabrics.

Oxidation of Ketones.—A. Popoff.—The second instalment of a lengthy monograph on this subject.

Direct Oxidation of Anthrachinon by means of Hydrate of Potassa.—V. Wartha.—This paper only contains the statement that, notwithstanding the assertion to the contrary made by Graebe and Liebermann, the author's researches on this subject (published some two years ago) are correct, and that consequently anthrachinon can be directly converted into alizarine by means of fusing hydrate of potassa

Researches on Sorbinic and Para-Sorbinic Acid.—R. Fittig and J. B. Barringer.—This excellent and very exhaustive memoir is divided into the following sections:—General introduction; sorbinic acid; hydrosorbinic acid and its salts; action of bromine upon hydrosorbinic acid; behaviour of hydrosorbinic acid with fusing caustic potassa; behaviour of sorbinic acid with bromine; para-sorbinic acid.

Contribution to our Knowledge on Benzyl Ether.—F. Sintenis.—Notwithstanding the high intrinsic value of this lengthy monograph, we can only quote here the headings of the different sections:—Benzyl-ethyl ether; action upon it of chlorine at the ordinary temperature and at its boiling-point; action of chlorine in the presence of iodine at the ordinary temperature; benzyl-methyl ether; chlorbenzyl ether; experiments with bromine and nitric acid; benzyl-phenyl ether; action of chlorine and bromine upon it at the ordinary temperature; products of substitution of benzyl-phenyl ether; action of chlorine upon benzyl-phenyl ether in the presence of oxide of mercury.

On Benzol Derivatives of Hydroxylamine.—W. Lossen.—The observation made respecting the foregoing essay also applies to this memoir, divided into the following sections:—Preparation of benz-hydroxamic acid and dibenz-hydroxamic acid; benz-hydroxamic acid, $NH_2(C_7H_5O)O$; salts of this acid; dibenz-hydroxamic acid—

$$NH(C_7H_5O)_2O;$$

salts of this acid; tribenz-hydroxy $N(C_7H_5O)_3O$.

Crystallographic Researches of the Substances Quoted in the Preceding Essay.—Dr. C. Klein.

Artificial Conversion of Bilirubine into the Colouring Matter of Urine.—Dr. R. Maly.—The author describes in this preliminary notice how bilirubine, when dissolved in dilute caustic alkali, and then treated with sodium amalgam, is converted into a pigment which has many points of resemblance with that present in normal human urine. The author is engaged with further researches on this subject.

Les Mondes, March 28, 1872.

Precious Metals in Bolivia.—Rev. F. Moigno.—In the district of Chaco, a silver ore has been discovered which yields 12,000 ozs. of silver to the ton, and at Saint-André de Mochaca and at Vilaquil very rich veins of gold have been found.

Fossils in the Republic of Ecuador.—Rev. F. Moigno,—Near Punin, a large quantity of fossil bones have been found, belonging among others to the mastodon, fossil horse, and other animals of the tertiary and quaternary geological periods.

Rain of Stones.—Rev. F. Moigno.—It appears that a violent thunderstorm at Rosano (Italy) was some weeks ago accompanied by a fall of pebbles varying in size from a small cob-nut to that of a large-sized pigeon's-egg.

Rain of Sand.—Rev. Father Denza, S.J.—The author relates that at Palermo, Cosenza, and Pérugia (Italy), there was clearly observed on March 4 and 10, at the respective observatories of these places, a rain of sand, which, on being viewed with the microscope, was ascertained to be due to the African desert. This phenomenon is not at all rare in Italy, and is well known also at Malta; the sand is carried over by the wind under certain circumstances.

Magneto-Electric Machine with a Continuous Current.—M. Gramme.—The lengthy description of a neat contrivance, illustrated by several woodcuts.

Tramways and Railways for Large Cities.—F. Michel.—This paper, illustrated by several woodcuts, deserves the attention of parties interested in this subject.

Dry Distillation of Wood.—P. Chipoff.—A very complete and practical account of this industry as carried on largely in Russia. This memoir is illustrated by engravings.

April 4, 1872.

Carbonate of Lead instead of Red-Lead for Crystal Glass.—M. Clernandot.—By the use in the glass mass of white-lead prepared by the Dutch method, the author obtains a more perfectly colourless glass than by the use of red-lead, because the latter is not quite so free from iron as the best white-lead, and it is the iron which imparts to the crystal glass a greenish hue.

Introduction of the Metrical System in the Austro-Hungarian Empire.—The official Gazette of Vienna of March 2 contains the Law of July 23, 1871, whereby the metrical system is to be introduced in the empire just named. The standard metre is a glass rod which, at the temperature of melting ice (0°), has a length of 999·99764 millims. The standard kilogramme is a crystal glass cube, the weight of which *in vacuo* is equal to 999·9978 milligrms. (both standards having been made according to the great platinum standards which are at Paris). The new system is to be in full compulsory force from Jan. 1, 1876, but in all official works the new system will be required to be adhered to on and after Jan. 1 next.

Preparation of Potassium.—Dr. Dolbear.—The author converts caustic potassa into sulphuret of potassium by passing sulphuretted hydrogen through the aqueous alkaline solution; this is evaporated to dryness, then intimately mixed with iron-filings, and next submitted to distillation in an iron retort heated to bright red heat, and the product of the distillation collected under the surface of refined coal-tar oil.

Osseine, Gelatine, Osmazome.—E. Monier.—In this essay the author expounds the divers nutritive and physiological properties of the three substances just named, which are often confused together. Osseine is nutritive, as proved in the case of dogs, wolves, and similar animals, who can digest bones and excrete the inorganic matter. Gelatine alone, and osmazome (largely contained along with salts in extract of meat), are not by themselves nutritive, but, as regards especially the latter, aid the digestion as a condiment.

Bibliography.—Under this heading we call attention to—"Traité Elémentaire de Chimie Organique," par M. Berthelot, Professeur au Collège de France, &c.; 1 vol., grand 8vo.; Dunod, éditeur; Paris, 1872. This work contains the *resumé* of the author's lectures on this subject as delivered for a period of twelve years. This work is here highly spoken of for its clear style and great completeness; no less than 10,000 organic compounds have been hitherto discovered, made, and studied, and the number which may be made is literally unlimited. Although not quite belonging to the books which we usually quote, we just mention, as we find it in the above-named periodical cited for curiosity's sake, the following:—"Journal d'un Diplomate en Italie Notes Intimes pour Servir à l'Histoire du Second Empire (1859-62)," pour M. Henry d'Odeville; Hachette, éditeur; Paris, 1872.

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics des Sciences et des Arts Appliquées à l'Industrie, No. 6 (double number), November and December, 1871.

This number does not contain any original papers relating to chemistry, but we call attention to a memoir—

Coal-Mining Industry of the Basin of the Don (Russia).—M. Semiatchkine.—The author states in the introduction that coal was discovered in this region by Peter the Great, who said on that occasion "Ce mineral sera utile, sinon à nous, du moins a nos descendants;" words which have been fully verified, as may be learned from the details of this memoir, which strongly exemplifies also the might of "Old King Coal" even in the far and remote south-east of Russia.

Bibliography.—Under this heading we call attention to a work which appears to be published in separate parts simultaneously in the German and French languages; the German title is "Wissenschaftlich Technisches Handbuch des Gesammten Eisengiesserei Betriebes," by E. F. Dürre, Professor of Metallurgy at the Royal Polytechnic School of Aix-la-Chapelle; published at Leipzig by A. Félix. From the review before us, it appears that this important work deserves to be in the hands of all who are interested in the theory and practice of the iron-smelting industry.

This number contains several important papers relating to engineering and railways.

NOTES AND QUERIES.

Estimation of Nitrogen by Combustion.—In a note printed in the last number of this journal, Mr. John Ruffle states that the nitrogen of the alkaline nitrates can be converted to and estimated in the form of ammonia by the soda-lime process, or a modification thereof. Having very frequently to estimate the nitrogen in manures containing nitrate of soda, I have found that Dumas's method is the only one extant by which the whole of the nitrogen can be determined. As examples of this I subjoin the results of the analysis of two samples of manures, both containing nitrate of soda, and tested by both methods—

	Percentage of nitrogen.	
	By Dumas's method.	By soda-lime method.
No. 1 sample	4·78	3·17
„ 2 „	3·85	2·90

Being acquainted with the mixing of each sample I was enabled to know that the results by the soda-lime method were too low. I have also tried the effect of the soda-lime combustion on pure nitrate of soda, the result showing that not a trace of ammonia is evolved. It would be a great advantage to have a method less costly and troublesome than Dumas's for estimating the total nitrogen in mixed manures, and if Mr. Ruffle will explain the nature of the "modifications" he has adopted, and the results he obtained, he will confer a benefit.—Walter Tate.

MEETINGS FOR THE WEEK.

Monday, April 29th.—Medical, 8.
—— London Institution, 4. Prof. Bentley, "On Elementary Botany."
—— Zoological, 1. Anniversary.
Tuesday, 30th.—Civil Engineers, 8.
—— Royal Institution, 3. E. B. Tylor, F.R.S., "On the Development of Belief and Custom amongst the Lower Races of Mankind."
Wednesday, May 1st.—Society of Arts, 8.
—— Microscopical, 8.
—— Royal Institution, 2. Annual.
Thursday, 2nd.—Royal, 8.30.
—— Royal Society Club, 6.
Royal Institution, 3. Dr. Tyndall, LL.D., F.R.S., "On Heat and Light."
—— London Institution, 7.30. Fourth Musical Lecture.
—— Chemical, 8. E. Riley, Esq., "On the Manufacture of Steel."
Friday, 3rd.—Royal Institution, 9. W. Spottiswoode, L.LD., F.R.S., "On Optical Phenomena Produced by Crystals when Submitted to Circularly Polarised Light."
—— Geologists' Association, 8.
Saturday, 4th.—Royal Institution, 3. R. A. Proctor, Esq., B.A., "On Star-Depths."

BOOKS RECEIVED.

Chimie Organique Elémentaire Leçons Professées a la Faculté de Médecine. Par Edouard Grimaux. Paris: Librarie Germer Baillière.

A Series of Chemical Labels for Use in Laboratories, &c. Published by Mottershead and Co., 1, Market Place, Manchester.

Proceedings of the American Pharmaceutical Association at the Nineteenth Annual Meeting. Philadelphia: Sherman and Co.

Elements of Chemistry, Theoretical and Practical. By William Allen Miller, M.D., D.C.L., LL.D. Revised by Herbert McLeod, F.C.S. Part I., Chemical Physics. Fifth Edition. Longmans and Co.

The Journal of the Iron and Steel Institute. Vol. I., 1872. London: E. and F. N. Spon.

Third Annual Report of the State Board of Health of Massachusetts. Boston: Wright and Potter.

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THE CHEMICAL NEWS.

VOL. XXV. No. 649.

THE ESTIMATION OF NITRIC ACID IN POTABLE WATERS.

By THOS. P. BLUNT, M.A., F.C.S.

THE following process for the estimation of nitric acid in potable waters will be found specially applicable in the case of the adoption of Wanklyn and Chapman's "ammonia process." It is a modification of one published some time ago by Mr. Vernon Harcourt.

The final residue of the distillations with hydrate and permanganate of potassium is transferred from the retort to a flask, which it should about one-third fill; it is raised to ebullition, and successive small quantities of sulphite of soda free from ammonia are added, until the whole of the permanganic acid has been reduced to the brown oxide; a few grains of recently-ignited charcoal powder are then introduced into the flask, and afterwards some aluminium foil, weighing eight or ten times as much as the nitric acid judged to be present; the flask is immediately connected, by a cork and bent tube, with a small Liebig's condenser, the other extremity of which, prolonged by a piece of glass tube with india-rubber connection, dips beneath the surface of some distilled water, free from ammonia, half filling a small beaker. When the evolution of hydrogen has nearly ceased, heat is applied, and distillation is carried on until about two-thirds of the liquid in the flask have passed over into the beaker, which will then contain in the form of ammonia the whole of the nitrogen contained in the nitric acid of the water.

The distillate is then transferred to a measuring flask, and the latter is filled up to the mark with distilled water; after mixing perfectly by agitation, one-tenth of the whole is measured off with a pipette, conveniently diluted, and the ammonia estimated by the Nessler test in the ordinary manner.

Should the ammonia in one-tenth of the distillate be insufficient to give a decided tint with the test a larger proportion may be taken, the amount being of course in each case calculated upon the whole, and ultimately estimated as nitric acid by the necessary proportion (1 : 3·7).

The object of the addition of the charcoal powder is to prevent the violent and troublesome bumping which usually occurs during the ebullition of caustic alkaline fluids; it will be found very useful in the ammonia process itself, where the tendency to turbulent boiling is still further aggravated by the permanganate of potassium used in the last stage.

ESTIMATION OF NITROGEN.

By BEAUMONT J. GROSJEAN.

WITH reference to Mr. Ruffle's communication on the above subject in the CHEMICAL NEWS (vol. xxv., p. 189), I may remark that it has for some time been known and mentioned in text-books that the nitrogen in nitrates is partially evolved as ammonia on heating with soda-lime. Thus, in Church's "Laboratory Guide" (1st. ed., p. 48), the analyst is directed to employ, in a determination of nitrogen, soda-lime "free from nitrate." Fresenius, in his "Quantitative Analysis" (4th ed., p. 453), refers indirectly to the same fact.

It is particularly desirable that some ready means should be devised of estimating nitrogen in substances like manures, which sometimes contain that element in three forms, viz., as organic nitrogen, as ammonia-salt, and as nitrate. It may be some aid towards attaining this object if I state a few experiments I have made.

The first experiment, which was suggested by Mr. R. Warington, was made with the view of determining the nitrogen in a nitrate by a modification of the well-known method in which platinised zinc, or zinc and iron filings, evolve the nitrogen as ammonia from an alkaline solution. A combustion was made with 0·768 grm. pure nitre, 22 grms. soda-lime, and 2 grms. iron filings. The nitrogen obtained was only 15·52 per cent of that employed. The employment of 5 grms. iron filings, in another experiment, gave a better result, viz., 26·86 parts nitrogen for 100 used. The third experiment was the same as the preceding with the addition of 0·75 grm. pure cane-sugar, which, it was hoped, would assist in the reduction of the nitrate. In this case the nitrogen obtained was 53·5 per cent of that put in. The progressive success of these experiments is an encouragement to proceed in a similar direction.

I then thought that if the nitrate in a substance containing also organic nitrogen could be decomposed in an alkaline solution by iron alone, a combustion could be made of the residue, and thus the remaining nitrogen obtained: it will at once be seen that the presence of zinc would greatly interfere with a combustion. 0·5 grm. pure nitre was placed in a retort, with 3 grms. iron filings, and soda solution (previously freed from nitrate by boiling with iron filings), and distillation carried on as usual. The percentage of nitrogen obtained was 14·47, theory being 13·85, showing an excess of only 0·62 per cent. There is no doubt that aluminium would answer the purpose still better, though it would involve more expense. It is only necessary to distil two-thirds of the contents of the retort to obtain by this means all the nitrogen present as nitrate and ammonia-salt. In the case, however, of substances containing also organic nitrogen, it would be necessary to carry the distillation still further, since I propose that, in such cases, a combustion should be made of the residue, and in the requisite evaporation to dryness some of the organic nitrogen would be evolved as ammonia and lost. I find it, however, unnecessary to carry the distillation to perfect dryness. If the mass in the retort be of the consistency of thin paste while hot, it will, when cold, be perfectly solid, and can then be powdered and submitted to combustion in the usual way. The latter part of the distillation is considerably accelerated by attaching an aspirator to the U-tube, which, with a tubulated receiver, contains standard acid to neutralise the ammonia; the pressure on the surface of the contents of the retort being lessened, distillation proceeds more quickly.

Since it is difficult to get the whole of the residue out of the retort with accuracy, I recommend the following plan:—Put an equal quantity of the substance to that treated as above into a beaker containing water, iron filings, and soda-lime which has been previously freed from nitrate if necessary, and carry evaporation on to the same point and at the same temperature as in the retort. This may be ensured by performing both operations in an oil-bath. While still pasty, the residue should be turned into a dish, the beaker freed from any that remains by means of water and weak acid, and the contents of the dish, after drying, powdered, and submitted to combustion. The ammonia thus obtained, added to that furnished by distillation, should give the total nitrogen in a substance containing organic nitrogen, ammonia-salt, and nitrate.

I think the direction has been indicated in which success may be expected, but further experiments are needed before the method can be deemed complete. Thus it may be mentioned that the addition of zinc to the retort containing a manure made with nitrate in alkaline solution, resulted in the production of more ammonia than when iron alone was used. I have, however, shown that the presence of zinc is not necessary with a pure nitrate, and it is remarkable that the authors and improvers of this method of estimating nitrogen in nitrate differ widely in the quantities they employ. Thus Harcourt employs 100 grms. zinc and 50 grms. iron for 1 grm. nitre, while Siewert uses 10 grms. zinc and 4 grms. iron.[*]

Perhaps a combustion of a nitrate with soda-lime in a current of hydrogen would furnish all the nitrogen in the form of ammonia.

QUALITY OF THE WATER SUPPLY OF LONDON.[†]

By H. LETHEBY, M.B., M.A., Ph.D., &c.,
Medical Officer of Health for the City of London.

This, as heretofore, has been the subject of regular investigation, not only in respect of the quality of the water supplied to the City, but also of that supplied to the whole Metropolis; and the principal facts of the inquiry are classified in the following table:—

Average Chemical Composition of the Metropolitan Waters for the year 1871.

Names of Water Companies, &c.	Total solid matter per gallon.	Common salt.	Oxygen required by organic matter, &c.	Nitrogen.		Hardness.	
				As nitrates, &c.	As ammonia.	Before boiling.	After boiling.
	Grs.	Grs.	Grs.	Grs.	Grs.	Deg.	Deg.
Thames Water Companies.							
Grand Junction	19·56	1·88	0·102	0·128	0·003	14·8	3·8
West Middlesex	18·71	1·83	0·040	0·124	0·001	14·4	3·3
Southwark and Vauxhall	19·44	1·91	0·089	0·125	0·003	14·8	3·8
Chelsea	19·48	1·87	0·093	0·136	0·003	14·9	3·3
Lambeth	19·79	1·79	0·082	0·123	0·003	15·0	3·8
Other Companies.							
Kent	27·69	2·56	0·010	0·215	0·000	20·7	5·7
New River	19·19	1·68	0·032	0·132	0·001	14·8	3·5
East London	20·39	2·10	0·060	0·143	0·001	15·0	4·0

The quantity of solid or rather saline matter dissolved in the water supplied to London during the year has ranged, in the case of the Thames supply, from 1871 grs. per gallon (West Middlesex Company) to 19·79 grs. (Lambeth Company); in the New River Water, which is that chiefly supplied to the City, it has averaged 19·19 grs. per gallon; in the River Lea water of the East London Company, 20·39 grs.; and in the water from the deep chalk wells of the Kent Company it has amounted to 27·69 grs. per gallon. The fluctuations of these proportions have not been considerable during the year, although in all cases the water has contained more saline matter in winter during wet weather than in summer—the maximum being in January and February, and the minimum in September. The hardness of the general supply has ranged, in the case of the river water, from 14·8° to 15° of Clark's scale, and this has been reduced to about 4° by boiling for a quarter of an hour. In the case of the chalk-well water, the hardness has been 20·7°, and after boiling it has fallen to 5·7°. The proportion of organic matter in the water has been very small, for the quantity of oxygen required to act on every description of oxidisable matter has ranged from only 0·01 of a grain per gallon in the chalk water of the Kent Company, to 0·102 of a grain in the Thames water supplied by the Grand Junction Company: and the amounts of ammonia and of organic nitrogen, as determined by Wanklyn's process, have not exceeded the 100th part of a grain per gallon of water.

As regards turbidity, the water supplied to the City by the New River and the East London Companies has been invariably bright and nearly colourless, and so also has been that of the Kent and the West-Middlesex Companies, but that of the Southwark and Vauxhall Company has been turbid on one occasion, that of the Lambeth Company on five occasions, and that of the Chelsea and of the Grand Junction Companies on eight occasions respectively. The turbidity has been at all times due to the presence of a very small quantity of finely-divided clay in which there was occasionally a trace of vegetable tissue; and no doubt it had been caused by the heavy floods of the river. Although perfectly harmless, a slight turbidity of the water is sure to command attention, and may easily be made the subject of popular clamour. On several occasions it has been described by the Registrar-General on the authority of Dr. Frankland in very alarming language, as that the water was turbid, very muddy, contained living organisms, was polluted with organic impurity, and was entirely unfit for domestic use. It is fortunate for both the water companies and the public that the Board of Trade has power, under the 35th and 36th section of the Metropolis Water Act, 1871, to institute inquiries into the truthfulness of such statements; and, accordingly, at the instance of the vestry of St. Mary, Newington, who were terrified beyond measure at the accounts given by Dr. Frankland of the condition of the water supplied to the parish, the Board of Trade appointed their officer, Major Bolton, who is the water examiner, to investigate the facts of the case; and in his report, which I have before me, he verifies the statement of Dr. Frankland as to the occasional turbidity of the water supplied by the Lambeth and the Southwark and Vauxhall Companies, and as to the presence of living organisms, but he attaches so little importance to the fact, that he says, "it is to be regretted that such terms as 'living organisms' and 'moving organisms' have been used so frequently and so indefinitely;" for not only do they exist in all water, but "it is impossible altogether to get rid of the simplest forms of vegetable and animal life, which should be understood by such terms, even by the most perfect filtration;" and in proof of the wholesomeness of Thames water, when properly filtered, he quotes from the Report of the Royal Commission on the quality of the water from the Thames Basin, to the effect that "in the present state of chemical science, analysis fails to discover in properly filtered Thames water anything positively deleterious to health. Whatever may be the difference of opinion with respect to the time required for removal of all the objectionable organic matter, all chemists agree that in Thames water taken from the present source, and properly filtered, all such matter has disappeared, and that the resulting compounds, such as nitrates, &c., remaining therein, are innocuous and harmless." Dr. Frankland, however, who is not a medical man, is not altogether of this opinion, for he thinks that water once charged with organic impurities is for ever after dangerous, and hence he uses the sensational phrase of "previous sewage contamination"—attributing all the combined nitrogen in water, with a small deduction for that which may have been acquired from the atmosphere during its fall as rain, to sewage or other such contamination; but the phrase, as Major Bolton remarks, is more alarming at the first glance than when closely examined; for it really implies—not that sewage or organic matter is contained in the water, but that the metamorphosed elements of these matters are present; and so they are in all the food we eat, for the corn, the fruit, the vegetables, and even the wine produced upon land manured with organic matter, must contain the metamorphosed elements thereof, and must, in the peculiar language of Dr. Frankland, be the products of "previous sewage or manure contamination;" but who cares for this when the meaning of the phrase is clearly understood? It is, however, unfortunate that the Registrar General should continue to employ it—seeing that it is constantly being misunderstood, and, therefore creating unnecessary alarm in the public mind. As an illustration of this I may refer to

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[*] Fresenius's "Quantitative Analysis." 4th ed., p. 348.

[†] From the "Report on the Sanitary Condition of the City of London, for the year 1870-71."

a report of the recently appointed medical officer of health for Lambeth, wherein he states that the water supplied to his district is "extensively diluted sewage." The publication of such a statement is sure to excite the gravest apprehension, which, as might be expected, is not confined to the district in question, but extends to the whole Metropolis. Officers of health have therefore had to allay the feeling of alarm, and in one case it has been made the subject of a special report. Thus Dr. Whitmore, who, like myself, has been engaged for years past in examining the water of his district, gives assurance to his vestry that it is "excellent in quality and perfectly wholesome." The subject has also commanded the attention of Dr. Alfred Swaine Taylor, F.R.S., the Professor of Medical Jurisprudence, and late Professor of Chemistry at Guy's Hospital, whose published report is before me. "There has been of late years," he says, "a great outcry on the subject of 'sewage contamination,' and some sanitary reformers have gone so far as to describe the Thames water as so much 'diluted sewage," "Dr. Whitmore," he says, "finds neither sewage nor the products of sewage decomposition in the water supplied by the West Middlesex Company. This," he adds, "is quite in accordance with the results which I have obtained by the examination of the water supplied to my house. Since the threatened approach of cholera in 1870-71, I have, for my own information, frequently examined the water for the products of decomposition, but have found none. As to 'previous sewage contamination,' I believe it to be a myth, if we are to understand thereby that the presence of sewage-products in water at any previous time renders that water noxious or unfit for use ever after. Those who adopt this theory can have but little faith in chemistry, or in the chemical changes which are going on around us;" and with regard to the phrase "living organisms," he says "if water is to be condemned as unwholesome and unfit for domestic use, because 'living and moving organisms,' *i.e.*, animalcules, are found in it, then there is no water in the world which can escape condemnation. The waters of the lakes of Wales and Cumberland, and even the water of Loch Katrine of Scotland, which is commonly taken as a type of purity for domestic use, would, on this ground, be pronounced 'undesirable for human consumption.' In short, those who would keep these minute infusorial animalcules out of any river or lake water on the earth, must adopt some scheme for preventing water-plants from growing in the water, or leaves, grass, or other organic substance from falling into it."

But the Registrar-General is not content with the use of these objectionable phrases, having reference to the quality of the water, and which are frequently associated with some statement respecting the dangers of cholera or typhus, and the connection of these diseases with bad water, but the quantities of the so-called impurities of water are represented in enormous proportions, as in thousands of tons. Dr. Taylor, however, thinks that "a gallon of water is an intelligible quantity. A man," he says, "may easily calculate within what period of time he consumes a gallon by daily use, and with it the 21 grs. of innocent solid substances contained in it. This is preferable to a system now adopted of giving the assumed constitution of 100,000 tons, or a corresponding number of kilogrammes or cubic metres of water. So enormous a quantity is, of course, beyond the reach of chemical analysis, and the tons of chalk, salt, and organic matter said to exist therein are only arrived at by multiplication. A ton of water represents 224 gallons. Within what period of time will a ton of water be consumed by any unit of the community? The answer to this question will show that such modes of laying plain matters before the public are more sensational than practical." The Royal Commission on Water have expressed themselves to the same effect, for at page 93 of their report, after condemning the term "impurities" as used by Dr. Frankland, they say, "And further, we cannot but consider it unphilosophical when, in addition to treating as 'impurities' substances perfectly harmless even in much larger quantities, the minute quantities present in a gallon, or any other small measure of water, are multiplied by taking masses of water, such as the individual never has to deal with, and given to the public in figures so large as to tend to cause misconception, and perhaps unnecessary alarm in the minds of those not conversant with all the conditions of the case."

I have been tempted to discuss this matter somewhat fully by the desire to allay any feeling of apprehension in the public mind as to the wholesome quality of the water supplied to this Metropolis, and I have endeavoured to show that although the phrases made use of by the Registrar-General on the authority of Dr. Frankland are at first sight undoubtedly alarming, yet when closely examined they are found to be but mere figures of speech, with, perhaps, a rather bold touch of exaggeration. It is, however, satisfactory to know that this kind of phraseology is quite exceptional, and is not used or even accepted, so far as I am aware, by any practical sanitary authority.

THE LOGWOOD TEST FOR ALUM IN BREAD.

By GEORGE E. DAVIS.

Some time since a few samples of bread were sent me for analysis; they were supposed to contain alum. Knowing that the logwood test was the one most easily applied, but remembering also the letters (Chemical News, vol. xxiv., pp. 131, 134, and 154) relating to the subject, I thought that before I applied the test I would experiment with certain salts upon pure water coloured a straw-colour with an alcoholic solution of logwood; for in the above letters upon the subject, one analyst states the colour for alum and logwood to be *deep purple* or *violet blue*; on page 134 the colour is stated to be *dark red*; whilst Mr. Richard Weaver, on page 154, states that he obtained two colours from different samples of bread operated upon, *purple* and a *fine blue*. It was to obtain some reliable information on this alum test, or rather the logwood reagent, that the following experiments were performed:—

The alcoholic extract of logwood was prepared as follows:—50 grms. of ground logwood was digested with 350 c.c. of methylated spirits in a warm place for twelve hours; the solution was then filtered into a stoppered bottle. One drop of this alcoholic solution gave a beautiful straw-yellow colour with 50 c.c. of distilled water, and this coloured solution was used in all the following experiments:—

It is to be remembered that all the reagents were applied to the straw-coloured solution in an extremely diluted state.

(1). To 50 c.c. of the straw-yellow solution in a conical precipitating glass, a few c.c. of a dilute solution of aluminium sulphate were added; for an instant the straw-yellow gave place to a bright yellow, then the solution became purple-red, and, after standing twelve hours, a purple. The colour was identical with a solution of permanganate of potash in water—in fact not to be distinguished from this latter—for when obtaining a solution of permanganate exactly similar in tint, I happened to be called away, and on returning, forgetting which was the logwood glass, I had to apply a chemical test to discover it. The reagent I applied was hydrogen sulphite, and of this acid I shall treat hereafter in connection with the logwood test for alum. Soda alum, potash alum, and ammonia alum each gives the same reactions as aluminium sulphate.

(2). To a similar quantity of the straw-yellow solution a solution of normal sodium tartrate was added, and a dark red with a brownish tinge was obtained. Rochelle salts and also ammonium tartrate gave the same reactions. *Two drops* of hydrogen sulphite solution were then added, and the dark red colour of the solution gave place *instantly* to the straw-yellow. *Two drops* of the hydrogen sulphite were then added to the colour produced by the alum; the colour was unchanged, although, after standing an hour, the colour was decidedly weakened. A very large excess of the hydrogen sulphite failed to destroy the reddish tinge of the solution. This experiment I hold important, for if "baking powders" have been used in the manufacture of the bread, sodium tartrate would be the ultimate product, and as "baking powders" are usually made up of a slight excess of the bicarbonated alkali, the next experiment also bears upon the point.

(3). When a dilute solution of a monocarbonated or caustic alkali was added to the test solution a dark red colouration was immediately formed, which gave the straw-yellow on adding two drops of hydrogen sulphite.

(4). To the test solution a few c.c. of a dilute solution of disodium hydrogen phosphate were added, when the alum colour was *nearly* imitated, it being a decided red-purple, and resembling potassium permanganate in an acid solution. This colour also turned straw-yellow on adding two drops of hydrogen sulphite. I may as well add that the solutions of all the reagents were made with pure distilled water, and the reagents themselves were carefully re-crystallised, and also that great care was taken to have the solutions perfectly neutral.

(5). Dilute ferric chloride gave with the test solution a blue-black colouration, which, when largely diluted, appeared very blue; in fact, a rich purple blue.

(6). Traces of ferrous sulphate gave also a blue-black, and both these colours give place to the straw-yellow on adding hydrogen sulphite.

(7). Ammonium hydrate was next added. Traces gave a red-brown which, upon further addition, turns violet and violet blue, and on neutralising the alkali with hydrogen sulphite the straw-yellow returns.

(8). Copper sulphate solution was now tried; it gave a purple colour, decidedly a *bluish purple*, more so even than alum, turning more blue on being allowed to stand, becoming, in fact, nearly a violet after the expiration of six hours. This blue-purple colour is replaced by the normal straw-yellow upon the addition of two drops of the hydrogen sulphite solution.

(9). Fifty c.c. of the water from the tap in the laboratory were taken and coloured with one drop of the logwood tincture, when the solution became tinged exactly as the alum solution, for when placed side by side they could not be distinguished; two drops of hydrogen sulphite were then added; the tap-water returned to the normal straw-yellow, whilst the alum solution was scarcely affected.

Now, the question forced itself upon me: If this water were used for bread-making, how would the bread produced comport itself with the logwood reagent? This could only be answered by a direct experiment, and, on testing the bread made with the water the straw-yellow colour of the logwood solution was not altered, but bread made with the water, the flour having had alum added to it purposely, gave a decided reddish-purplê colouration, which was not changed to purple-blue on standing, nor turned to straw-yellow on addition of a drop of concentrated hydrogen sulphite solution. Most of the acids bring back the red colours to straw-yellow, but I prefer to use hydrogen sulphite, as it is a weak acid and can be only driven off by heat if required.

We have, then, three distinct colours having some resemblance to each other but varying in tint, and by the above experiments I think I have shown that this resemblance of colour is no hindrance to the detection of the alum colouration, for all the colours are turned yellow except the alum where the solutions are acidified with hydrogen sulphite.

I know from conversations with various analysts upon the subject of alum in bread, that the logwood test is not of very high repute, and this acted upon me as an incentive to find what action other salts had, when present in traces, upon the logwood reagent.

Mr. Richard Weaver says, upon p. 154, vol. xxiv., that all the specimens which gave a blue colouration with the logwood test contained potatoes; this induced me to try potatoes *by themselves*. A decoction of the potatoes, both baked, boiled, and raw, gave a similar colour to the sodium phosphate, which was immediately turned yellow upon adding one drop of hydrogen sulphite. I tried many kinds of potatoes, and obtained many tints, but those tints *never* approached even a blue.

A sample of bread was then tested which was known to contain potatoes, and it was found that it gave a colour identical with that which the potatoes (which it contained) gave, but that colour would never be mistaken for the alum colour, for although it had a tinge of purple, yet it was decidedly red, which immediately became straw-yellow on adding hydrogen sulphite solution. Will other chemists give their experience of this logwood test?

Radcliffe, April 16, 1872.

THE SUCCESSIVE ACTION OF SODIUM AND IODIDE OF ETHYL ON ACETIC ETHER

CRITICALLY EXAMINED AND INTERPRETED ON THE PRINCIPLES OF THE TYPO-NUCLEUS THEORY.

By OTTO RICHTER, Ph.D.

Professor Frankland and Mr. Wanklyn, the two distinguished chemists to whose original and extensive labours the lovers of science are indebted for so many solid and valuable materials, will, I fear, consider it an act of great presumption on my part that I should have chosen for the theme of my present communication "the successive action of sodium and iodide of ethyl upon acetic ether;" more especially when it is seen that I have no new facts to contribute, and when I cannot but know that these gentlemen, who are leading authorities on this subject, differ greatly in their description of the concomitant phenomena, although it is urged by the latter chemist, and, I believe, tacitly admitted by the former, that, notwithstanding these discrepancies, the chief products of the reaction are absolutely identical. Under these circumstances, most people would think it absurd and preposterous to select such an unfinished and evidently very intricate case for the theme of theoretical speculations. Nevertheless, when I put into the other scale of the balance the all-important object I have in view—viz., to vindicate the superior claims of the "typo-nucleus" theory over the still prevailing, but, in my opinion, unsound and unprofitable, doctrines of the "typo-radical" theory; when I can give convincing proof that the purer rays of light which emanate from the centre of that theory are capable of illuminating some of the darkest features of this hitherto inscrutable problem; in short, when the consciousness of a good and noble cause prompts me to persevere to the utmost, I feel confident that the parties alluded to, as well as the profession at large, will not refuse to accept this special plea as a sufficient apology for what might otherwise be censured as a great want of tact and common sense. It is on these exceptional grounds that the reader is now requested to lend an indulgent ear to the lucubrations of an honest and candid inquirer, who will consider himself amply rewarded if competent judges would kindly condescend to subject his theory to the ordeal of an impartial but severe criticism.

The successive action of sodium and iodide of ethyl on acetic ether has engaged the attention of some of our most experienced chemists, but it is chiefly to the profound and elaborate researches of Professor Frankland and Mr. Wanklyn that I am indebted for positive and reliable information on this subject. No doubt a great deal remains to be done, for the practical difficulties with which this question is surrounded are neither slight nor few. A considerable obstacle to our gaining a deeper insight into the precise nature of the various processes which have given birth to such an abundance and diversity of substances has, however, lately been removed by the important discovery that the seemingly contradictory statements of different observers are perfectly reconcileable on the experimentally well-grounded hypothesis that there exists an intimate relation between the degree of gaseous pressure which is brought to bear upon the mixture of sodium and acetic ether, and the quantity of hydrogen which is evolved during the reaction. Indeed, on the trustworthy authority of Frankland, who was in the habit of conducting his experiments under the ordinary atmospheric pressure, torrents of hydrogen gas nearly equal in bulk to the calculated theoretical amount were being emitted during the whole course of the operation; while, on the equally trustworthy authority of Wanklyn, who was in the habit of performing his experiments in sealed tubes, and consequently under a much higher degree of pressure, only a very small quantity of this gas, and sometimes none at all, could be detected. Now there appears to me nothing peculiarly remarkable in the simple fact that alterations of pressure may exercise a certain modifying influence in all those cases where the evolution of gas forms one of the prominent features; but what strikes me as something very strange and mysterious is the almost incredible, but apparently well-founded, assertion, that, notwithstanding these extreme variations in the quantity of eliminated hydrogen gas, the chief products of the reaction, inclusive of a certain number of their derivatives, are strictly identical. Wanklyn, at all events, declares them to be so, while Frankland, from not openly contradicting this statement, seems to be of the same opinion. Impelled by an irresistible desire to fathom and penetrate the mystery of these reactions, I resolved to examine this singular case through the powerful microscope of my "typo-nucleus" theory. The following is a brief summary of the information I have been able to gather with the aid of this, to me, invaluable instrument:—In the first place, I was not slow in perceiving that I had to deal with one of those rare and exceptional cases, where two *distinct kinds of chemical action* may be provoked in the same solution by simply altering the degree of *external pressure*. In the second place, I convinced myself that the chief products which emanate from these two modes of action, as well as the derivatives obtainable from these products, were not *identical*, but only *isomeric*. On these premises it became at once intelligible to me why Frankland, who was always experimenting at the one extremity of the scale of gaseous pressure, should have realised that set of compounds only, the production of which involves the disengagement of hydrogen gas in quantities exactly proportionate to the number of sodium molecules substituted for it, whilst Wanklyn, who was always experimenting at the other extremity of the scale of gaseous pressure, should have realised that set of compounds only, the production of which precludes the evolution of hydrogen gas. Having now acquainted the reader with the different, and in one sense also opposite, methods of proceeding which these two acute and careful observers thought proper to follow (and in the interests of science it was very fortunate that they did so), and having introduced to him the most eminent contributors of materials to what, I fondly hope, will soon stand out as a noble and everlasting monument to the skill and perseverance of competitive genius, it is meet that we should likewise engrave thereon the honoured names of artists who, like Löwig, Geuther, Lippmann, Wislicenus, and others, have been, or are still, diligently engaged in the practical elaboration of this fascinating but intricate problem, and with whose original or confirmatory researches I shall here and there have occasion to interweave my narrative.

The programme of this narrative consists of three parts. In the first part, I shall enlarge on the genetic relations and chemical constitution of that series of chemical compounds and derivatives which emanate from Prof. Frankland's experiments. In the second part, I shall enlarge on the genetic relations and chemical constitution of that series of chemical compounds and derivatives which emanate from Mr. Wanklyn's experiments. In the third part, I shall dilate on the various species of ketones which are engendered in the destructive distillation of these substances, and briefly explain the nature of the molecular changes which accompany their formation. I shall then endeavour to prove, by a variety of collateral experimental evidence, that the two most conspicuous members of these series —viz., Frankland's ethaceton-carbonic ether and Wanklyn's ethyl-triacetyl—are really constructed upon two distinct chemical types or patterns, and that these constitutional differences are rendered manifest by their general chemical deportment, as well as by the nature of the products of their destructive distillation. I shall, finally, subjoin a synoptical arrangement of chemical formulæ, exhibiting the genetic relations between Frankland's and Wanklyn's series on the one hand, and the lactyl series on the other hand.

PART I.

On the Genetic Relations and Chemical Constitution of that Series of Chemical Compounds and Derivatives which emanate from Professor Frankland's Experiments.

The first question which naturally suggests itself with reference to these experiments is, to identify the particular hydrogenised constituent in the acetic ether molecule which, under the influence of the sodium, is made to furnish the evolved hydrogen gas. Now, in my system of notation* the chemical constitution of acetic ether is expressed by the formula $2H_4C_4; H_2O_2.2H_3C_2; 2C_2O_3$, so that the hydrogen which is set free must proceed either from the ethylen-adjunct of the modified water base, or from the methyl-adjunct of the modified oxalic acid. The chemical deportment and composition of the resulting products and their derivatives incontestably prove that it is the latter adjunct and it alone. Taking this for granted, we can readily understand how the successive displacement of the three methylic hydrogen molecules by a corresponding number of sodium molecules will give rise to three varieties of substituted acetic ethers, which are distinguished by Frankland as sodacetic ether, disodacetic ether, and trisodacetic ether; and it is important to state that Wanklyn has likewise succeeded in obtaining the first-named compound by the action of ethylate of sodium on acetic ether, which shows that the soda has first of all been reduced by one of the methylic hydrogen molecules with production of ethylic alcohol, and that the liberated sodium has afterwards stepped into its place. Wanklyn, however, has thought proper to call his substance, which I believe to be chemically identical with the sodacetic ether of Frankland, by the term acetate of ethylen-sodium, implying thereby that it is not one of the methylic hydrogen molecules, but one of the ethylen-hydrogen molecules which has interchanged places with the sodium. I have searched everywhere, but in vain, for some striking experimental evidence in support of this, in itself, by no means unreasonable supposition; but I flatter myself that the contents of the following pages will convince the reader, and perhaps also Mr. Wanklyn, that his hypothesis cannot be seriously maintained. Besides the three aforesaid varieties, Frankland accomplished to obtain yet another and more complex group of sodium compounds, which involve the co-operation of two acetic ether mole-

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* The reader will bear in mind that the various marks of punctuation used in my formulæ are typical symbols of molecular grouping. Thus, a dot connects the base with its acid; a semicolon connects the hydrocarbon adjunct with its principal; an inverted semicolon connects the halogen adjunct (which includes every species of mono- or poly-normal acids, bases, or salts) with its principal; and a colon connects two or more simple hydrocarbons with one another. Observe, also, that in my rational formulæ the non-essential constituents are generally separated from the essential constituents by a horizontal line, and that the empirical formulæ used in my system are exactly the double of the ordinary formulæ. $H_2=2$; $C_2=12$; $O_2=16$.

cules. The first of these bodies is mentioned in his memoir under the name sodaceton-carbonic ether, and the second under the name disodaceton-carbonic ether. I shall in the sequel endeavour to demonstrate that these two species of compound ethers are formed by the chemical union of sodacetic ether and disodacetic ether respectively with a peculiar kind of alcohol, the hydrocarbon adjunct of which is represented by the condensed carbon molecule $2C_4$, and to which I shall apply the term deacetylic alcohol. This condensed carbon molecule occupies the second place in the series of multivalent carbon molecules pertaining to the first type of my metachemical system. They are all held to be incapable of existing in the free state, but to acquire stability in the form of adjuncts, as, for instance, in combination with the hydrogen nucleus of a water base. It is no doubt true that not a single one of the corresponding alcohols has as yet been obtained in a state of isolation, but their occurrence in combination I believe to be as certain as it is theoretically indispensable. The subjoined list shows the relation of these species of alcohols to each other and to their more or less hydrogenised isologues.

List of Primary Alcohols.

Formethylic or Demethylic. $2C_2;\ H_2O_2.H_2O_2$	Methylic. $2H_2C_2;\ H_2O_2.H_2O_2$		
Deacetylic. $2C_4;\ H_2O_2.H_2O_2$	Acetylic or Deethylic. $2H_2C_4;\ H_2O_2.H_2O_2$	Ethylic. $2H_4C_4;\ H_2O_2.H_2O_2$	
Deacrylic. $2C_6;\ H_2O_2.H_2O_2$	Acrylic or Deallylic. $2H_2C_6;\ H_2O_2.H_2O_2$	Allylic or Depropylic. $2H_4C_6;\ H_2O_2.H_2O_2$	Propylic. $2H_6C_6;\ H_2O_2.H_2O_2$
&c.	&c.	&c.	&c.

The generation of the aforesaid deacetylic alcohol out of the elements of the second conspiring acetic ether molecule may be briefly explained as follows:—One of the methylic hydrogen molecules becomes oxidised at the expense of the associated oxalic acid, when the resulting water molecule by combining with the ethylic ether base gives rise to 1 molecule of ethylic alcohol. In the existing conditions, the residual oxyacetylen, $2H_2C_2;2C_2O_2$, is then supposed to experience that peculiar kind of isomeric transformation which removes it from the category of genuine acids into the category of genuine alcohols. In this process the carbonic oxide is completely deoxidised by the two hydrogen molecules of the methylen adjunct, while their respective carbon molecules, which are now set free, coalesce under the condensed form, $2C_4$, and are then held to unite as hydrocarbon-adjunct with one of the two newly-formed water molecules, while the other assists in the production of deacetylic alcohol. Finally, this alcohol, by connecting itself as halogen-adjunct with the neighbouring molecule of sodacetic or disodacetic ether, gives rise to Frankland's sodaceton- or disodaceton-carbonic ether. I may here mention that Professor Geuther was the first in preparing the aceton-carbonic ether (his diacetic ether) by treating the former of these sodium compounds with hydrochloric acid. The formula of this ether is therefore—

$$\frac{H_2O_2. \qquad 2H_4C_4;\ H_2O_2.}{2C_4;\ H_2O_2 : 2H_3C_2;\ 2C_2O_3},$$

and it is clear that the successful introduction of acids or bases into the alcoholic constituent would furnish strong experimental proof in favour of my mode of reasoning, which endows it with all the attributes of a true biatomic water salt.

Let us, in the next place, turn our attention to that very remarkable class of derivatives which Professor Frankland obtained by subjecting his sodium compounds to the action of iodide of ethyl. All these derivatives have one striking feature in common, which is that they are produced by the successive substitution of 1 molecule of ethyl for 1 molecule of sodium in the methyl-adjunct of the acetic ether. And here it is necessary for me to state that, in formulating the resulting complex hydrocarbon-adjuncts, I have been guided by a peculiar principle, the nature of which it is impossible for me to elucidate here without greatly exceeding the limits of the present communication. For further information I must therefore refer the reader to my paper "On the Chemical Constitution of the Hydrocarbons," which will soon be ready for publication. The derivatives just alluded to may be divided into two sets. The members of the first set are obtained by the action of iodide of ethyl on sodacetic and disodacetic ether respectively, and comprise (1) the ethacetic ether with the formula—

$$\frac{2H_4C_4;\ H_2O_2.}{2(H_6C_4:HC_2);\ 2C_2O_3},$$

and the diethacetic ether with the formula—

$$\frac{2H_4C_4;\ H_2O_2.}{2(H_6C_4:H_4C_4:HC_2);\ 2C_2O_3}.$$

The members of the second set are obtained by the action of iodide of ethyl on sodaceton- and disodaceton-carbonic ether respectively, and comprise (1) the ethaceton-carbonic ether (ethdiacetic ether of Geuther), with the formula—

$$\frac{H_2O_2. \qquad 2H_4C_4;\ H_2O_2.}{2C_4;\ H_2O_2 : 2(H_6C_4:HC_2);\ 2C_2O_3},$$

and (2) the diethaceton-carbonic ether—

$$\frac{H_2O_2. \qquad 2H_4C_4;\ H_2O_2.}{2C_4;\ H_2O_2 : 2(H_6C_4:H_4C_4:HC_2);\ 2C_2O_3}.$$

Reserving my remarks upon these four derivatives for Part III., I shall now request the reader to accompany me to the other extremity of the scale of gaseous pressure, where Mr. Wanklyn had been in the habit of performing his experiments. When this skilful manipulator, in reliance upon the harmonious results of his own carefully conducted experiments, took it upon him to challenge the accuracy of Professor Frankland's statements, it may well be imagined, that not only the illustrious author of these statements, but along with him a number of competent and sympathising judges, were filled with alarm and astonishment at the bold assurance with which this charge was preferred, for it became patent to every one that the imputed error, if really committed, was of a nature to detract from the world-wide reputation of one of our greatest living experimentalists. No wonder, therefore, that scientific men began to watch with keen and anxious eye the further progress of this remarkable case, which is still pending, but which, it is to be hoped, will terminate to the satisfaction of all parties concerned. In the earlier part of this paper I have already had occasion to allude to certain facts having been brought to light which lead to the pleasant conclusion that no blame attaches to either of the two observers, whose respective reports, though more or less contradictory of each other, are perfectly correct in their way, but rather, if that were possible, to the capricious character of the observations themselves. This important point being settled, the whole charge must fall to the ground, and I for one shall rejoice to learn that the two chief actors in this singular contest have formed the noble resolution of resuming this most interesting and instructive problem in friendly communion with one another; and, since we are all labouring for a common cause, let each one of us, according to the measure of his abilities, endeavour to share with these gentlemen the honour of paving the road for a more comprehensive and more truly rational system of chemical philosophy. With these prayers and sentiments, sincerely uttered on my part, and re-echoed, I fondly hope, by that chosen band of enlightened and devoted chemists who spend the best portion of their time, their talents, and their treasure in the discovery and propagation of scientific truth, I shall invite the reader to accompany me to the second part.

(To be continued).

ON MEAT AND THE METHODS OF PRESERVING IT.

By H. ENDEMANN, Ph.D.

MEAT is composed of various substances, which, up to the present time, are not yet all known. Their number is being increased every few years by new discoveries, which, however, do not always meet the expectations of over-zealous admirers of Liebig's Extract. Theories, which attribute to newly-discovered substances the life-giving power which has made the extract of meat a medicine, must be confirmed by physiological experiments; whereas, thus far, they have failed entirely to assign a specific function to any of the products of the decomposition of albuminous substances formed in the living organism. I may therefore avoid any omission in the enumeration of the component parts of meat, by grouping all these substances under the general heading, "Products of the Decomposition of Albumen."

Meat consists of fibrin and albumen (about 25 per cent) and the rest of the solid constituents (about 2½ per cent in the average) is composed of the products of decomposition of albumen and of alkaline salts. The albuminous substances, fibrin and albumen, represent the nourishing properties of meat, while the salts, possessing likewise nourishing qualities, are important for the promotion of digestion. About twenty years have elapsed since Liebig made his first investigations on the constituents of meat. It was then also that he advanced his views concerning the nourishing properties of the extract of meat, and we find in the *Chemische Briefe*, published shortly afterwards, his ideas set forth so clearly that the unprofessional reader may understand and duly appreciate them.

I feel confident that the value of this extract was and is, even now, over-estimated. Liebig himself abandoned the idea that the organic constituents of the extract were the agents of its beneficial effects, and experiments, made some years ago in England, show plainly that the ashes of the extract are capable of producing the same effects as the extract itself. Even now, however, after the explosion of the theories, that albuminous substances might be built up again from the products of their decomposition, experiments are constantly made to find organic constituents capable of producing the effects of the extract itself, as is evidenced by the recent discovery of carnine, the physiological effect of which is, according to the experiments, more than doubtful. Liebig states that "the extract, which is produced by extracting meat by cold water, is the nourishment for the muscle;" but the meat liquor is not only the agent of transmitting the nourishment from the blood to the muscles, it also contains the waste products formed during the action of the muscles. Liebig in preparing his extract, however, excludes the real nourishment by coagulating it, and carefully collects the products of decomposition for the good of humanity.

But, if the alkalies alone constitute the value of this extract, is there not a waste of most valuable material? The interest of the manufacturer will not be disputed, but why does the intelligent consumer pay dollars for that which he might buy for a few cents?

The fact is, that the public is as yet in the dark; the published experiments are known in most cases only to scientific men and command attention, while the want of support by illustrious names makes them soon forgotten. For the proper utilisation of meat, the albuminous as well as the extractive portion must be preserved, for the former not only re-supplies the body with albumen, which had become decomposed by the action of the muscles, but serves also as a combustible, while the extractive portion is necessary for a proper digestion. Let us see how these requirements are fulfilled by the methods in vogue for the utilisation and preservation of meat.

When meat is salted, it is treated with an excess of salts (common salt and saltpetre), which absorb the water, forming a concentrated solution, which contains besides these salts much of the extractive portion of the meat. This solution is removed before using the meat, and the latter is even soaked in fresh water for some time, to remove the excess of salts. It is evident that such meat is very poor in extractive salts, and for this reason very difficult to digest.

The action of smoke depends upon the carbolic or cresylic acid contained therein. These substances coagulate the albumen and fibrin, and thus prevent decomposition. Smoked meat is therefore not so easily digested as raw beef, since not only the gastric juice must remove the carbolic acid before digestion is possible, but the albumen and fibrin, being already coagulated, will resist more strongly the dissolving action of the juice. The conditions will be even more unfavourable for a proper digestion, if the salting and smoking process have been combined.

One of the most rational processes of modern invention is the preservation of meat by enclosing it in air-tight cans. This process would undoubtedly give full satisfaction, if it were not for mechanical difficulties, which cannot as yet be surmounted. If properly carried out, however, it is the best process known, because it furnishes the meat in its pure and unadulterated state, the great agent of decomposition, atmospheric air, being excluded.

When we come to consider the different agents of decomposition, we find that they are, first the atmospheric air with its myriad germs and spores, and secondly water. No decomposition is possible without the latter, and I propose therefore the following method of preservation. The meat, after having been cut in slices, should be dried in a hot-air chamber, at a temperature below 140° F. If the apparatus is well constructed, the drying may be completed within three hours, if filtered air be drawn rapidly through the chamber.

In this operation the meat becomes quite hard, and can easily be ground in a mill. It is then in the condition which is best adapted for use. The fibrin and albumen not being coagulated, are able to take up water and the fibres expand into their natural state.

The powder is of a slight brownish yellow colour, has a trifling odour of roast meat, and keeps exceedingly well. This proves that the salts contained in the meat are entirely sufficient for its preservation, if the quantity of water keeping them in solution is greatly diminished by evaporation.

Its use is easily understood. For beef soup—two ounces of the powder are boiled for a few minutes with one pint of water and the other usual ingredients. The soup thus prepared will be stronger than that prepared from half a pound of fresh meat, for a solid piece, even after long boiling, will never permit as thorough extracting as the meat powder.

For solid roast meat dishes, the addition of one egg to a pound of meat powder, together with the requisite quantity of water, suffices to re-unite the separated fibres by means of the coagulating egg-albumen.

The fact that the albumen and fibrin are not coagulated makes it a valuable medicine for consumptives, and in all cases of debility where good nourishment is requisite. It is even more easily digested than raw meat, for the reason, that, if it is taken with cold or lukewarm water, the process of swelling will take place in the stomach, where, being surrounded by gastric juice, the latter is absorbed.

This I have tested by actual experiment. Corresponding quantities of raw meat and meat powder were digested in glass flasks, under the influence of equal quantities of diluted muriatic acid and pepsine at a temperature of about 110° F. While the contents of the vessel containing the meat powder, after six hours treatment, represented a uniform, though not quite clear fluid, the vessel containing the raw beef contained yet pieces of the undigested material. A dog was fed for eight days with a daily ration of 5 ounces of meat powder, corresponding to about 1 pound of fresh meat. The average weight of the discharges from the rectum was about one-fourth ounce daily (dried at 200° F.), the maximum being 8·5 grms., the minimum 5·2 grms. Microscopical examination did not show even traces of undigested meat fibre. The only part of the meat found undigested were the relics of the sinews. Pieces of wood, cork, paper, and threads of the carpets formed, besides the mucous membranes and constituents of the bile, the solid part of the excrements. The dog, who had formerly been fed on mixed food, grew very lively during this treatment. His weight at the end of the treatment was 12½ pounds.

As no apparatus in which the temperature could be regulated during the drying of the meat existed, I have been obliged to construct one according to my own ideas.

This apparatus is so constructed, that the air is sucked through it by an exhauster moved by steam-power. Two valves, one for hot air, the other for cold air, the air being filtered in both cases through cotton, and both acting under the equal outside pressure, supply the apparatus with pure dry air of a certain temperature, which is regulated by the aid of a thermometer. An apparatus of this kind is in operation at my laboratory.

The drying room of this apparatus measures 27 cubic feet. The air is heated by steam-pipes carrying 60 lbs. pressure, and having 27 square feet heating surface. The exhauster is an inverted quadruple Fan blower of the Rahway Manufacturing Company, of Rahway, N. J., and removes by 420 revolutions 25 cubic feet of air per minute.

By increasing the heating surface and using a larger exhauster, the apparatus may be made more effective yet, so that 100 lbs. of beef can be easily dried within three or four hours.—*American Chemist.*

ON SOME REACTIONS OF SOLUBLE GLASS.

By F. A. FLUCKIGER.

Vogel has recently demonstrated that in mixing concentrated solutions of silicate of potassa, and borate of potassa, which contain an excess of caustic potassa, silicic acid is separated. Several investigations have directed the writer to the general law, that *the salts of potassium, sodium, lithium, and ammonium most readily soluble in water, have especially the power of separating silicic acid from concentrated solutions of soluble glass.* For instance, the following salts possess this property in cold saturated aqueous solutions: of the ammonium salts, the chloride, bromide, sulphide, phosphate, molybdate, nitrate, acetate; of the sodium salts, the chloride, nitrate, nitrite, arseniate; and among the potassium compounds, the iodide, sulphide, sulphocyanide, tartrate, and acetate.

Though most of these salts, by slight dilution, quickly lose this property of separating silicic acid, several ammonium salts retain it to a considerable degree. If, for instance, one mixes a solution of silicate of soda of sp. gr. 1·392, with 29 parts of water, and adds a few drops of a sal-ammoniac solution (1 : 8 of water), there results, with gentle warming, a separation of silicic acid, though here hardly 2 per cent of the silicate is in the solution. With only ½ per cent of silicate present, chloride of ammonium will hardly cause, after some time, a slight cloudiness, while both sulphocyanide and nitrate of ammonia will immediately precipitate silicic acid in it.

Cold saturated solutions of bromide of potassium or chloride of potassium do not decompose the soluble glass solution referred to, at ordinary temperatures, but do so readily when warm. Sulphate of soda, also, does not act when warm, if cold water has been saturated by the crystallised salt (Glauber's salt); but if the Glauber salt is dissolved in so little hot water that one part of anhydrous sulphate exists in two parts of water, the silicate solution brought to the same temperature will be precipitated by the sulphate of soda.

The relation of the nitrate of soda to the soluble glass solution tested by the writer is worthy of note. With a sp. gr. of 1·392, this left behind after evaporation and ignition 62·8 per cent residue, which, beside the silicate, contained small quantities of chloride of sodium and sulphate of soda. This solution contained so small an excess of alkali that the first drops of alcohol, or an acid solution of any kind, gave a precipitate. If now this soluble glass was decomposed with a solution of nitrate of soda in one part of water, silicic acid separated. If, however, one added nitrate of soda to two parts of water, and mixed equal parts of this solution with the soluble glass, no precipitated resulted. If, however, the mixture was warmed up to 54° C. the silicic acid separated in gelatinous form and the mixture almost entirely solidified. If the experiment was conducted in a flask, and the flask was then suddenly brought back to the ordinary temperature, or cooled down to 0° the separated gelatinous precipitate re-dissolved as quickly. This experiment one can repeat at pleasure.

Caustic ammonia, sp. gr. 0·921, with a solution of soluble glass, sp. gr. 1·392, gives a copious precipitate of gelatinous silica. If the flask is closed and warmed, the precipitate soon re-dissolves. Only this all depends upon the proportions of the mixture. In ten parts of the silicate solution, one part of ammonia causes no change. If one increases the amount of alkali to two parts, the greater part of the silica is precipitated. If the mixture is warmed in a closed flask to 90° C., re-solution of the precipitate soon takes place. After cooling, the gelatinous silica again forms. If one mixes 6 to 8 parts of the soluble glass with 1 part of ammonia (both solutions having the degree of concentration above mentioned) in a closed flask, at about 30° C., a quite clear liquid is obtained, which, however, at a moderate temperature, very soon separates into two layers of nearly equal volume. The upper layer was slightly yellowish, of sp. gr. 1·064, and left on evaporation and ignition not over 9 to 10 per cent residue. When this was repeatedly treated with dilute nitric acid, hydrochloric and sulphuric acids were found abundant in the filtrate. The lower layer was syrupy, entirely colourless, and gave 38 to 45 per cent ignited residue, in which there existed notably either no chlorides and sulphates or very slight traces of them. Though the light liquid soon gave off ammonia on warming it, the same alkali was persistently retained by the heavy liquid. If, however, the latter was evaporated to dryness, the purest, most colourless glass remained, which when boiled with caustic potash disengaged ammonia.

A drop of bromine, or a jet of chlorine gas immediately separates silicic acid from a soluble glass solution. Iodine is unable to effect this reaction. But this property is possessed in the highest degree by creosote from boxwood and phenol (carbolic acid). Also pure chloral hydrate, which leaves a silver solution and litmus paper quite unchanged, is in a form to decompose the silicate of soda in concentrated aqueous solutions.

Dilute solution of the white of a hen's egg, and a solution of glue, also precipitate silicic acid. An emulsion of almonds separates no silica. It has long been known that gum arabic also causes the decomposition of soluble glass. The precipitate contains no gum, but after washing consists essentially of silicic acid. Its formation is, however, affected by the amount of salts that the gum contains. A gum solution decomposed by HCl, and dialysed, after thorough neutralisation with ammonia, gave no precipitate in soluble glass. Sugar, dextrine, glycerine, &c., have no power to separate silicic acid.—*Repertorium der Pharmacie.*

MISCELLANEOUS.

Presentation of an Address to Professor Tuson.—On the 7th ult., the following address was presented to Professor Tuson by the pupils of the Royal Veterinary College, who had attended the course of laboratory instruction in practical chemistry:—"To Richard V. Tuson, Esq., F.C.S., Professor of Chemistry and Materia Medica in the Royal Veterinary College. Sir,—We the undersigned Students of the Royal Veterinary College beg to acknowledge most heartily the efforts you have made to facilitate the acquirement of a practical knowledge of such a difficult subject as chemistry. While our opportunities for studying this important science were confined to those afforded by attendance on lectures only, the facts and principles of this branch of the curriculum were retained in the memory with extreme difficulty, but since we have had the privilege of working with our own hands in the laboratory, we find that we make greater and more rapid progress, and that we can more thoroughly appreciate the value and practical utility of chemistry to every one desirous of following the profession of veterinary medicine on sound and rational principles. We also beg to congratulate you on your being the first to establish a course of laboratory instruction in the oldest and principal veterinary college of this country; to thank you most sincerely for the sacrifice of your valuable time which you have voluntarily and gratuitously made for our benefit and advancement; and to hope that you may long be spared to participate in that in which you have manifested such a deep interest, *videlicet*, the education and elevation of the social status of the veterinary student."—(Here follow the signatures of seventy-seven students).

How to Fasten Rubber to Wood and Metal.—As rubber plates and rings are nowadays used almost exclusively for making connections between steam and other pipes and apparatus, much annoyance is often experienced by the impossibility or imperfection of an air-tight connection. This is obviated entirely by employing a cement which fastens alike well to the rubber and to the metal or wood. Such cement is prepared by a solution of shellac in ammonia. This is best made by soaking pulverised gum shellac in ten times its weight of strong ammonia, when a slimy mass is obtained, which, in three to four weeks will become liquid without the use of hot water. This softens the rubber, and becomes, after volatilisation of the ammonia, hard and impermeable to gases and fluids.

Detection of Starch in Mustard.—The following letter addressed by Dr. Doremus to the New York *Evening Post* has been forwarded to us for publication:—"During my recent illness I was shown an article of your issue of January 17, entitled the 'Testimony of Experts at Fault,' in which I was represented as giving evidence under oath, upon a scientific question, on a basis so trivial that a single experiment demonstrated its error. I venture to respond, for the first time in my professional career, to a personal attack through the public journals. I had been asked to analyse a sample of 'Coleman's Durham Mustard,' which I found to be largely adulterated with flour; turmeric and red pepper being employed to impart colour and pungency to the same. As part of my testimony I stated that mustard seeds contain starch. Other experts, supported by recognised authorities, testified that mustard seeds do not contain starch. My opinion was formed from producing the colour test with iodine in test-tubes and on filtering-paper, from seeing the blue starch granules on glass slides with the microscope, and from precipitating the suboxide of copper from an alkaline solution of the soda-tartrate of copper after the starch had been boiled with diluted hydrochloric acid. I testified that the reason why these experts and other investigators had failed to detect the starch granules was that the mustard seeds contain substances which interfere with the iodine reaction. I had discovered and showed to the court that the sulphocyanides prevent the production of the blue iodide of starch, and will discolour very deep blue solutions of this iodine. As these compounds are found in both varieties of mustard seeds, unless they are removed it is impossible to reveal the existence of starch by the iodine reaction, excepting occasional granules, which may be detected with a powerful microscope, even without this precaution. The freshly-boiled mustard to which your correspondent 'B.' alludes, was employed to demonstrate to the court the presence of the sulphocyanide, by using a persalt of iron, and obtaining the blood-red sulphocyanide of this metal, whereas, the sample of seeds with which I produced the blue iodide of starch on filtering-paper, had been so treated as to remove the compound of sulphur and cyanogen. The pouring of a diluted solution of iodine upon filtering paper was a repetition of an experiment I had made to the court some hours before, without obtaining a blue tint; but the solution, weakened by evaporation of the iodine, yielded the tint in question, even without the mustard seeds, or the turmeric which had been tested for starch in a similar way. It is clearly a *non-sequitur* that, therefore, neither mustard seeds nor turmeric contain starch. I have since found that all filtering paper will yield a more or less distinct blue tint with an extremely diluted solution of iodine. The truthfulness of my position may be determined by any chemist who will subject the mustard seeds to the precautionary steps I have narrated before applying his tests.—I have the honour to remain your obedient servant, R. Ogden Doremus, 70, Union Place."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 8, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Second Note on the Crystallisation of Baryta Salts the Acids of which are Derived from the Water in which Corpses have been Soaked in Anatomical Theatres.—Professor E. Chevreul.—The eminent author points out in this paper a peculiar behaviour of certain salts which crystallised spontaneously and very slowly, one of these exhibiting the shape of the crater of a volcano, while the other, seen under the microscope, exhibited an appearance not unlike the *méandres* of the *renaissance* style of architecture. The author will shortly give an account of the nature of four acids found in the water alluded to.

Alteration which the Sulphur-Water of Eaux-Bonnes (in the Pyrénées) Undergoes by a Limited Contact with Air.—L. Martin.—The author calls attention in this paper to the peculiar mode of decomposition which the native mineral water of the locality alluded to undergoes when it is in contact with air in reservoirs; the first change is the rapid conversion of the monosulphide of sodium, present in the water as issuing from the rocks, into bisulphide, with the simultaneous production of silicate of soda; the second alteration is the slow, but progressive, always partial, conversion of the bisulphide into hyposulphite of soda by the fixing of oxygen. The water alluded to contains in fresh state 2 equivs. of silica for 1 equiv. of monosulphuret of sodium. The silicate formed by the alteration of the water in reservoirs is a quadrisilicate.

Researches on the Apparent Volatilisation of Selenium and Tellurium and on the Dissociation of their Hydrogen Compounds.—A. Ditte.—The contents of this very lengthy memoir are, notwithstanding the high scientific merits, not suited for useful abstraction.

Reducing Properties of Hydrogen and the Vapours of Phosphorus, and on the Application of the same to the Making of Drawings upon Paper.—B. Renault.—In this paper the author first calls attention to the fact that, when a jet of hydrogen is directed against filtering-paper (Swedish) previously impregnated with any salt of silver, the latter is reduced to the metallic state, while the paper becomes thereby blackened. Instead of hydrogen gas, carbonic acid or nitrogen may be used which has been passed over lumps of phosphorus (which is absorbed and carried in the state of vapour along with these gases in very small quantity; the author found in a litre of carbonic acid gas, at temperatures of 4°, 15°, and 17°, from 0·8 m.grm. to 1·2 m.grms. of phosphorus), and it will then even blacken carbonate of copper. In the next place, this paper is devoted to the detailed description of the manner in which this property of hydrogen and vapour of phosphorus may be applied for the production of writing and other tracings upon paper.

Combination of Binoxide of Chromium and Bichromate of Potassa.—D. Tommasi.—By causing binoxide of nitrogen to act upon a boiling solution of bichromate of potassa in fuming nitric acid, there is formed what the author terms dichromate kalichromic—

$$[(CrO_2)_3(CrO_3)_2K_2O]H_2O,$$

an amorphous brownish-violet coloured powder, devoid of taste and smell; sp. gr. at 14°=2·28; it is completely insoluble in water, alcohol, acetic acid, &c.; heated to above 300°, it fuses, becoming decomposed into sesquioxide of chromium, oxygen, bichromate of potassa, and water; cold nitric acid does not act upon this substance, but, by boiling, some of it is dissolved, and converted into chromic acid; cold and concentrated sulphuric acid has no action on the powder, but, when warm acid is employed, the powder is dissolved, yielding a green-coloured fluid, which, on being neutralised with ammonia, yields neutral chromate of that base; aqueous sulphurous acid dissolves the powder, which, with boiling hydrochloric acid, gives off chlorine; the percentage composition of this body is—Chromium, 46·1; potassa, 16·6; water, 3·1; oxygen, 34·0.

Researches on the Part which Organic Matters in the Soil Play in the Nutrition of Plants.—L. Grandeau.—This essay treats on the functions of organic matter in the soil, and contains an account of some experiments made with large samples of portions of soil known as the black soil of Russia, taken at vertical sections of 3 metres depth at Uladowka, which soil has never been manured and yet produces excellent and abundant crops. The main results of the author's investigation are—(1) That fertile soils contain the nutritive mineral elements in the same shape as these are present in farmyard manure; (2) that the fertility of a soil is intimately connected with its richness in mineral elements and in organic matter soluble in ammonia; (3) that the organic matters are the natural vehicles for mineral elements, which are extracted by them from the soil and offered to the roots of plants in an assimilable shape.

Chemical and Microscopical Analysis of the Meteoric Sand Rain which Fell in Sicilia on March 9, 10, and 11.—O. Silvestri.—This exhaustive memoir contains the results of the researches made on rain-water along with which fell a kind of sand; the water, having been filtered, was found to be colourless and free from smell, but exhibited a saline taste; it was neutral to test-paper; hardness, 17·5 degrees (ordinary rain-water, 1 degree). By long-continued boiling, it gave off 19½ c.c. of gas, consisting of—Nitrogen, 83·959 per cent; oxygen, 13·070; CO_2, 2·971. On being evaporated to dryness, this water was found to contain, in 1000 parts—Bicarbonates of lime, 0·129; of magnesia, 0·035; of iron, traces; sulphate of lime, 0·041; chloride of potassium, traces; sulphate of soda, 0·009; chloride of sodium, trace; organic matter, 0·063. The sand, very finely pulverised and dust-like, has a sp. gr.=2·5258, and contains, in 100 parts—Clay, 75·08; carbonate of lime, 11·65; organic matter, 13·19.

Researches on the Chemical Composition of Chinese Green (Lokao).—S. Cloez and E. Guignet.—After briefly referring to the history of the discovery of lokao, and the investigations of D. Kœchlin, Persoz, sen., Michel, Charvin, and others, the authors treat on the substance alluded to, which they say is a genuine lake colour. The sample operated upon by them was found to contain 9·4 per cent of water and 26·2 per cent of ash. The action of water upon lokao, insoluble in that fluid, does not present any great interest; by the action of alkalies (carbonated), the authors have extracted from the lake a blue-coloured material, which they term lokaine. Ammoniacal lokaine, $C_{56}H_{33}O_{33},NH_4O$, is a true salt, the pure lokaine being a weak acid; by the action of dilute sulphuric acid (1 of acid to 20 of water) upon ammoniacal lokaine, there is formed lokaetine, $C_{18}H_{18}O_{10}$, a substance almost insoluble in water, but which becomes violet-coloured by the smallest trace of an alkali. With nitric acid, lokaetine yields, in addition to oxalic acid, a yellow colouring matter, soluble in alcohol and ether, but this body is not picric acid, from which it differs completely. Strong sulphuric acid dissolves lokaetine in the cold, and water precipitates from this solution a brownish coloured matter, which yields with weak alkalies a deep-green-coloured substance, soluble in alcohol; the formula of this body is $C_{18}H_6O_8$.

We regret to learn, from a short communication in this number, the death of the celebrated German *savant* Dr. Hugo von Mohl, a well- and deservedly-known botanist, who died at Tübingen (Würtemberg) on April 1.

Revue Hebdomadaire de Chimie Scientifique et Industrielle,
February 22, 1872.

Horn and Tortoiseshell.—C. Mène.—A complete, yet succinct, account of the various mechanical and mechanico-chemical operations by means of which horn and tortoiseshell are converted into various articles made of these substances.

Use of Permanganate of Potassa for the Quantitative Estimation of Sulphurous Acid and Sulphites.—Dr. Hamel.—The author uses a titrated solution of permanganate of potassa acidulated with hydrochloric acid for the purpose of quantitatively estimating sulphites, or rather the sulphurous acid, present in these salts; and as regards free sulphurous acid in solution, it is first neutralised with a solution of carbonate of soda. The moment the violet colour of the permanganate appears, the reaction is finished, and the calculation made according to the formula—

$$Mn_2O_7KO+5SO_2=KO,9MnO+5SO_3.$$

The permanganate solution is titrated according to Hempel's plan with oxalic acid.

Bichromate of Lime as a Substitute for Animal Charcoal in the Sugar Industry.—C. Mène.—It appears that there has been lately imported into Boston, U.S., a large parcel of West Indian raw sugar, which has been treated with bichromate of lime (method not described), and is found very superior to raw sugar made with animal charcoal, while a great saving in expense is also made.

Process for Uniting Caoutchouc to Wood and Metals.—C. Mène.—The author says that a solution of shellac in liquid ammonia is a suitable glue for fastening caoutchouc to wood and metals.

Coating Metals with Nickel by the Moist Way.—C. Mène.—Wrought- and cast-iron, steel, copper, brass, zinc, and lead can be so coated by putting these metals, or objects made of them, in a boiling neutral solution of chloride of zinc, to which a salt of nickel is added, and also zinc, in granulated state or sheet. If the solution be acid the coating will be dull. When, instead of a salt of nickel, one of cobalt be used, a coating of that metal may be obtained.

Method of Dyeing Veneer Wood.—C. Mène.—The wood to be dyed is first steeped for twenty-four hours in a solution of caustic soda, and boiled with it for half an hour. It is then washed, to remove all the alkali, and then (the wood having become as soft as leather and equally elastic, as well as capable of absorbing dye-stuffs) immersed for twenty-four hours, first into a decoction of logwood, and next, after having been superficially dried, into a boiling solution of sulphate of iron (1 part of the salt to 3 of water). When the wood is desired to be yellow-dyed, it is immersed into a solution of picric acid (1 part to 60 of water), to which enough ammonia is added to cause the fluid to smell of it. Wood treated as mentioned with soda may be also dyed with coralline. The dyes are fast, stand varnishing, and thoroughly penetrate through the whole of the wood, which, after drying, may be sawn and veneered.

Animal Charcoal as Antidote against Phosphorus.—Drs. Eulenberg and Wohl.—Based upon experiments very successfully made with animals, the authors propose the use of animal charcoal, made up into pills with gum adraganth, as a very efficient antidote against the bad effects of phosphorus in the lucifer match manufactories; and they prefer the substance alluded to above oil of turpentine, which, though an effectual antidote against phosphorus, causes, in many instances, very severe headaches when internally taken.

Industrial Manufacture of Trichloracetic Acid from Hydrate of Chloral.—C. Mène.—Hydrate of chloral is mixed with its own weight of strong fuming nitric acid, and exposed for three or four days to direct sunlight. The mixture is next distilled; and as soon as the thermometer plunged in the liquid marks 195°, that temperature is kept up, the distillate being trichloracetic acid. This reaction takes place according to the following formula:—

$$2NO_5+C_4Cl_3O_2.HO=2NO_4+\underbrace{C_4Cl_3O_32H}_{\text{Trichloracetic acid.}}$$

The acid just named resembles acetic acid to some extent, and is now used in medicine for cauterising warts, corns, and other excrescences. When trichloracetic acid is boiled along with an excess of ammonia, chloroform and carbonate of ammonia are formed.

Preparation of Suboxide (Red Oxide) of Copper Suitable for Colouring Glass.—Dr. Bœttger.—Heat together in a porcelain basin 300 grms. of sulphate of copper; 450 grms. of sal seignette, tartrate of potassa, and soda; 600 grms. of cane sugar; and 3600 grms. of water. When the solids are dissolved, add 450 grms. of caustic soda, and boil, stirring the liquid occasionally and replacing the water which evaporates. After about one hour's boiling the liquid will have become colourless, and there will be deposited about 80 grms. of the red oxide, which is washed by decantation and next dried at a gentle heat.

February 29, 1872.

Continuation and End of the Lecture on the Services which Chemistry has Rendered to Agriculture.—Dr. Barral.

Gas-Furnace for Smelting Metals.—MM. Perrot and Wiesnegg.—The description, illustrated by a woodcut, of a very ingeniously contrived gas-furnace capable of producing very high temperatures, and of very moderate cost—viz., £2 15s.

Estimation of Ammoniacal Salts.—Dr. Rabuteau.—The author's mode of operation is based upon the decomposition of ammoniacal salts and other nitrogen-containing substances by bleaching-powder (hypochlorite of lime), nitrogen gas being set free and collected. The mode of operation is as follows:—A solution of bleaching-powder in water is first treated with a solution of carbonate of soda (2 parts of the latter for 1 part of the former, or 100 grms. of bleaching-powder and 200 grms. of carbonate of soda upon 2 litres of fluid); 200 c.c. of the rather dilute solution of the ammoniacal salt to be tested are taken and poured into a flask; there being next added to the saline solution an excess of the clear hypochlorite of soda liquor. The flask, having been provided with a cork in which a gas delivery-tube is fitted, is next heated, and the nitrogen given off collected in a graduated tube and measured with the required and well-known precautions. Care should be taken to render the decomposition of the ammoniacal salt complete by using a relatively small quantity of the salt in proportion to the hypochlorite solution.

New Colouring Matter from Aniline.—C. Mène.—Two parts of nitrite of aniline and 1 part of arsenic acid are heated together for five minutes to from 80° to 120°; the contents of the vessel in which this operation takes place are poured into boiling-water, and the fluid neutralised with lime. The liquid, which turns a beautifully red colour, is filtered through flannel, and the filtrate is next added to chloride of sodium in the proportion of five times the quantity of the nitrite of aniline used. The result is the precipitation of the new colouring matter, which is named saffranine, collected on a filter, and next submitted to pressure to remove water. Saffranine is used instead of safflower for dyeing wool and silk.

Newly-Contrived System for Concentrating Sulphuric Acid.—M. de Hemptinne.—In the year 1854, Dr. Kuhlmann suggested that sulphuric acid might be, perhaps, concentrated in vacuum pans, since lead is not perceptibly acted upon by that acid, even when concentrated at a temperature not exceeding 200°. The author, manufacturing chemist at Molenbeeck, St. Jean, near Brussels, is stated to have solved the practical difficulties which beset the use of leaden vacuum pans (the atmospheric pressure on a square metre of surface of vessels in which a vacuum is made is equal to a dead weight of 10,000 kilos., and lead, as is well known, is a soft, yielding metal), by constructing a vacuum pan provided with glass and glazed fire-clay stays, which are not acted upon by the acid, and thus capable of withstanding the external atmospheric pressure, while the concentrated acid (boiling-point in air, 325°) may be boiled at from 190° to 195° under reduced pressure.

March 7, 1872.

Use of Amorphous Silica as a Fixing Agent (Mordant) for Dyes and Pigments.—M. Reimann.—It appears that when fabrics made of cotton, flax, or other vegetable and animal fibres, are first treated with a silicate of soda solution, and next with a weak acid solution, the fabrics so prepared are suitably mordanted for taking up many dyes and pigments, especially the so-called tar colours.

Newly-Contrived Smoke-Preventing Chimney Top.—M. Chalès.—The arrangement, illustrated by woodcuts and fully described, appears to be an excellent plan of preventing smoky chimneys in private houses.

Wood Varnish for Furniture and other Wooden Objects.—C. Mène.—To 1 kilo. of very fluid copal varnish are added 15·62 grms. of best boiled linseed oil, and the mixture heated for the purpose of making the incorporation complete. The wood to be varnished is first coated with a solution of gelatine, to which either some precipitated chalk or some red ochre is added, according to the nature of the wood (light or dark-coloured naturally). When the coat of varnish is dry the varnished article is rubbed with a solution of wax in ether.

Sulphur as a Lubricating Material.—J. Ménard.—To 100 kilos. of good colza oil the author adds 5 kilos. of sulphur, and heats this mixture to from 130° to 140° until all the sulphur is dissolved. It is said that, being a bad conductor of heat, sulphur has the service here of preventing the heat caused by the friction of machinery to be carried over upon the oil, which therefore can serve for a longer period than usual as a lubricating medium.

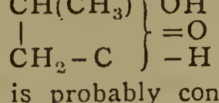
La Revue Scientifique de la France et de l'Etranger, April 13, 1872.

This number contains the following essay:—

What is Force?—Dr. P. de Saint-Robert.

We also meet here with a brief account of the proceedings of the meeting of the Chemical Society of Paris held on April 5, from which we quote the following:—

New Product of the Condensation of Aldehyde.—Dr. Wurtz.—When a mixture of water, aldehyde, and hydrochloric acid, is left to itself for a fortnight, next saturated with carbonate of soda, then well shaken up with ether, there is obtained, by the evaporation of the latter, a viscous thick mass, which is purified by distillation *in vacuo*, when the substance comes over at between 95° and 105°; this body is so viscous that the vessel in which it is contained may be inverted without the substance flowing out. This body has a high refractive power, is soluble in water, alcohol, and ether, and its simplest formula is $C_4H_8O_2$. The further investigation of this compound proves it to act as an aldehyde as well as an alcohol; it reduces nitrate of silver, forming a metallic mirror on glass, and combines with acetic acid, yielding a liquid acetate, which may be distilled *in vacuo* between 90° and 95°, and is composed of $C_4H_7O_2(C_2H_3O)$. The constitutional formula of this body is—



$$\left.\begin{array}{l}CH(CH_3)\\ \mid\\ CH_2-C\end{array}\right\}\begin{array}{l}OH\\ =O\\ -H\end{array}$$

By nascent hydrogen, it is probably converted into butyl-glycol, $C_4H_{10}O_2$. When it is tried to distil this body at the ordinary pressure, it is dissociated, yielding water and crotonic aldehyde, C_4H_6O.

Synthesis of Orcin.—A. Henniger and G. Vogt.—When chlorated toluen, C_7H_7Cl, is dissolved in sulphuric acid, there is formed a sulpho-conjugated acid, the potassa salt of which, termed by the authors chloro-cresyl-sulphite of potassa, C_7H_6Cl,SO_3K, yields, when fused with caustic potassa, orcin, salicylic acid, and cresylol; the two latter substances are, however, due to a secondary reaction. The formation of orcin, $C_7H_8O_2$, is elucidated by the following formula:—$C_7H_6Cl,SO_3K + 2KHO = C_7H_8O_2 + KCl + SO_3K_2$. The orcin thus formed has been ascertained to be in every respect identical to that obtained from lichens, even as regards the coloured reactions.

Solvent for Oxides of Copper and Chromium.—M. Prudhomme.—In the presence of oxide of chromium, oxide of copper is stated by the author to be soluble in potassa and soda solutions, while oxide of chromium, by itself insoluble in ammonia, dissolves in that fluid when oxide of copper is present in it.

Silicate of Ethyl.—Dr. Friedel.—The author has succeeded in obtaining silicate of ethyl by heating, for some hours in a sealed tube, iodide of silicium with an excess of ether to 100°. On opening the tube, after cooling and distilling the contents, ordinary ether is volatilised, along with iodide of ethyl first, and at 160° silicate of ethyl comes over; the reaction is elucidated by the following formula:—

$$\underbrace{SiI}_{\text{Iodide of silicium.}} + \underbrace{8(C_2H_5)_2O}_{\text{Ether.}} = \underbrace{Si(OC_2H_5)_4}_{\text{Silicate of ethyl.}} + \underbrace{4(C_2H_5I)}_{\text{Iodide of ethyl.}}.$$

This number also contains an interesting and noteworthy account of the meetings of the Geological Society of Paris held on April 4 and 8, and a well-written biography of the late well-known *savant* P. A. E. Laugier, just deceased at Paris, where he was highly appreciated as an eminent astronomer and member of the Bureau des Longitudes.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, March, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Report on Two Essays of Dr. Sacc Relating to the Action of Nitric Acid and Caustic Soda upon Drying and Non-Drying Oils.—Dr. Barral.—The main contents of this paper appeared in our pages about two years ago; the reactions are of practical value for the purpose of distinguishing between different kinds of oils.

Description of a Furnace for Treating Iron Ores According to Ponsard's System.—M. Grüner.—This paper is accompanied by a series of engravings. The object of this furnace and mode of smelting ores is to convert the same into wrought-iron or steel in one operation,

Report on Objects Made of Iron and Cement by J. Monier.—M. Paliard.—This paper contains an account of a method of constructing various objects of a framework of iron, which gives support to cement; not only ornamental, but also useful, objects are made by this method.

Les Mondes, April 11, 1872.

Meeting of the Delegates of the Learned Societies, and Report of the Proceedings.—Dr. Blanchard.—A valuable review of the scientific researches made in France in the course of the last year: to several scientific men, gold and silver medals have been awarded, either for prize essays or for peculiar scientific researches. Incidentally, we are here reminded that ozone was first noticed, and some of its properties described, by Dr. van Marum, one of the directors of Teyler's institution at Haarlem, in 1785; the name ozone is, however, due to Schœnbein's researches.

Programme of the Physical Researches and Observations about to be Made in the Mont Cenis Tunnel by the Rev. A. Secchi, S.J., the Engineer Diamilla-Müller, and the Rev. Father Denza, S.J.—Pendulum observations; meteorological observations, inclusive of magnetic, and observations on the temperature of the rocks, will be made; very accurately made instruments will be used. Our readers are probably aware that there exist in the tunnel spaces, termed lateral chambers, which will serve for the purposes alluded to.

MEETINGS FOR THE WEEK.

MONDAY, May 6th.—Medical, 8.
—— London Institution, 4. Prof. Bentley, "On Elementary Botany."
—— Royal Institution, 2. General Monthly Meeting.
TUESDAY, 7th.—Civil Engineers, 8.
—— Royal Institution, 3. E. B. Tylor, F.R.S., "On the Development of Belief and Custom amongst the Lower Races of Mankind."
—— Zoological, 9.
WEDNESDAY, 8th.—Society of Arts, 8.
Geological, 8.
THURSDAY, 9th.—London Institution, 7.30. Lecture.
—— Royal Institution, 3. Dr. Tyndall, LL.D., F.R.S., "On Heat and Light."
FRIDAY, 10th.—Royal Institution, 9. Nevil Story Maskelyne, Esq., F.R.S., "On Meteoric Stones."
—— Astronomical, 8.
—— Quekett Microscopical Club, 8.
SATURDAY, 11th.—Royal Institution, 3. R. A. Proctor, Esq., B.A., "On Star-Depths."

NOTES AND QUERIES.

Grey and Brown Acetate of Lime of Commercial Qualities.—Will any reader kindly inform me how to estimate the quantity of acetic acid in the above articles in a ready manner, or refer me to any treatise from which I could learn a simple process for this purpose, either by volumetric analysis or precipitation?—S. S.

TO CORRESPONDENTS.

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T. R. Ogilvie.—This correspondent is thanked for his communication; we are glad to comply with his request.

T. B. Blunt and J. Mayer.—Received with thanks.

M. H. Hills.—The last edition of Plattner's work is the best.

Chemicus.—You should advertise for a copy.

A Constant Subscriber.—The English edition of Wagner's "Technology." It will be published in a few days.

C. P.—We are not aware of any chemical process which will restore the brilliancy.

E. Jones.—The last edition of Sutton's "Volumetric Analysis."

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THE CHEMICAL NEWS.

Vol. XXV. No. 650.

REPORT ON THE WORKING OF THE A B C PROCESS OF UTILISING SEWAGE AT CROSSNESS.*

By GUSTAV BISCHOF,
Professor of Technical Chemistry in the Andersonian University, Glasgow.

The author describes an ingenious improved contrivance for mixing the sewage and A B C mixtures. The sewage, in running through the channel leading to the tanks, sets a water-wheel in motion, which again imparts motion to an ordinary governor, such as is commonly used for steam-engines. The governor is in connection with a valve, through which the A B C mixture is admitted to the sewage channel. The quicker the motion imparted to and by the water-wheel, the wider is the valve opened by the action of the governor, and thus the proper admixture is automatically regulated. The mixed sewage and A B C mixture is then run into a series of six reservoirs or settling tanks, each 50 feet long, 20 feet wide, and about 7 feet deep. The mud having settled down, the effluent is drawn off by pipes, while the mud, after being passed into tanks, dried, and ground, is ready for the market.

The area of land occupied by the Crossness works is about 250 feet by 150 feet, or rather more than three-quarters of an acre.

The author observed during his visit of some days to Crossness, that the treatment of sewage by the A B C process causes no offensive odour. The effluent is perfectly clear and devoid of smell. The drying of the mud was not in operation during the author's stay, but he was informed that no offensive gases were evolved.

The Crossness Works are styled "Model Works" for the reason that the various operations are carried on in open apparatus to enable those interested in the subject to satisfy themselves on all essential points of the process. In ordinary cases the operations are carried on underground, and the author thinks the process may be worked close to and even in large towns and cities without any inconvenience or injury to the inhabitants, thus saving the expense of conveying the sewage to a great distance.

In reply to the question whether the effluent be sufficiently pure to be discharged into rivers, the author gives the results of an analysis of the Leeds effluent recently made by Mr. Crookes, who found in 100,000 parts of the sewage—

	Total Solid Impurities.	Organic Carbon.	Organic Nitrogen.	NH_3.	Total Contained N.	Cl.	Suspended Matter.		
							Mineral.	Organic.	Total.
(1).	111·40	0·77	1·16	2·31	3·06	14·4	1·25	0·59	1·84
(2).†	—	2·00	0·30	—	—	—	3·00	—	—

The maximum amount of organic carbon allowed by the Rivers' Commissioners is 2·00 and 0·30 of organic nitrogen, so that, according to Mr. Crookes's analysis, the organic nitrogen is not sufficiently removed. The author proposes to effect this by irrigating land with the effluent which, being free from smell, can be carried at little cost in open trenches to any distance. But where irrigation is impracticable, it is proposed to filter the effluent. Dursley earth has been proposed as a filtering medium by Dr. Frankland. A qualitative analysis by the author proved this earth to be almost completely soluble in hydrochloric acid. The solution contained proto- and peroxide of iron, a little alumina, much lime, a little magnesia, a moderate proportion of the alkalies, much carbonic acid, silica, 0·15 per cent of phosphoric acid, and traces of sulphuric acid.

Mr. Stanford's kelp-ash has been also suggested as a filtering medium, while Dr. Spencer proposes magnetic oxide of iron. The author proposes spongy iron. An analysis of a sample of Mr. Spencer's carburetted iron proved that it did not contain a trace of metallic iron. The purifying action of magnetic oxide of iron appears to be mainly due to the ferrous oxide present. Mr. Spencer attributes this action to its physical property of attracting atmospheric oxygen to its surface, and then transferring it to organic substances, which thus become oxidised.

Spongy iron, on the other hand, is metallic iron reduced from an oxide without fusion. The author refers to an experiment tried, and analytically controlled, by Professor Voelcker, which shows that by means of this iron, sewage may become, using Dr. Voelcker's own words, "purer than many drinking waters." It decolourises many organic substances to such an extent that beer, for instance, may, by slow filtration, be completely decolourised. Its purifying action is much more complicated than the action assigned by Mr. Spencer to the magnetic oxide. Spongy iron has the property of decomposing water, probably due to the galvanic current produced by the contact of iron and carbon. The oxygen thus produced may have a powerful oxidising action on organic matter.

During filtration some of the iron is dissolved, probably, by the action of the carbonic acid contained in water. As the purification of water progresses some five or six hours after passing through spongy iron, whilst the purification is stopped at once, and rendered much more incomplete if the solution be boiled directly after its filtration through spongy iron, the author concludes that organic matter may reduce the iron dissolved as above whilst in a low state of oxidation to a still lower oxide, which, by the action of the atmospheric oxygen of the water, or by the oxygen above referred to, is re-converted into the higher state of oxidation, the iron thus acting as the carrier of oxygen to organic matter. These conclusions are corroborated by the author's observation, that the purifying action is also greatly diminished by the addition of a minute quantity of sodium carbonate, which prevents the solution of the iron.

The dissolved iron, after peroxidation, probably has the property of mechanically carrying down with it the impurities of water.

How long the spongy iron will remain active has yet to be ascertained by practical trials. It can be revived and purified at little cost by heating in a furnace with the addition of carbonaceous matter.

Supposing even none of these proposals for filtration give satisfactory results, the discharge of an effluent of similar composition to that analysed by Mr. Crookes, into the Thames or other rivers, instead of the raw sewage as is now done, would, in the author's opinion, be a great and material improvement.

The author proceeds to consider how far the manurial value of the so-called native guano represents the manurial value of sewage, and whether the demand is likely to render the process a commercial success.

In the analysis of the effluent there is no phosphoric acid; thus all phosphoric acid contained in sewage must have passed into the guano. As far as it is possible to determine, raw sewage contains, in 100,000 parts, some 6·7 parts of ammonia; this figure being the average of the six samples re-

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* Abstract of a paper read before the Chemical Section of the Glasgow Philosophical Society.

† Column 2 represents the maximum amount allowed by the Rivers' Commissioners.

ferred to in the report on the "Treatment and Utilisation of Sewage" of the committee appointed by the British Association. As the effluent contains 2·31 ammonia, about 66 per cent of it may have passed into the guano. It may be remarked that the average of ammonia in the effluent from sewage which has been utilised by irrigation, is stated in the above report equal to 1·5, but as the lowest figure, at Breton Farm, is 0·202, and the highest, at South Farm, 3·436, it is but reasonable to expect a better average result if the conditions which have been found essential in irrigating be universally adopted.

Although chemical analysis does not assign a great manurial value to the native guano, it appears from the above figures that the utilisation of sewage by the A B C process is satisfactory. On the other hand, there is a great waste by the irrigation system, for Mr. Denton states that the same amount of cropping was produced by applying in one instance, from 12,000 to 15,000 tons, and in the other, only 4000 tons of sewage.

The result attainable by the so-called native guano for manurial purposes has already been practically tested. The author refers to more than a hundred highly favourable opinions expressed by farmers after practical trials of the native guano, extended over a period of two years. Some sixteen or eighteen more were unfavourable, but most of these last could be distinctly traced to utter sterility of the soil, or to mismanagement in applying the native guano. It is well known, of course, how easily such opinions are "got up" in reference to the action of drugs on the human system, and so on, but it is not so easy in the case under consideration, where the actual result could be, and was, estimated by weights and measures.

The author replies to the objection that the little value demonstrated by chemical analysis is due chiefly to the A B C mixture, by stating that this does not affect the manurial value of the guano, if the cost is £1 10s. per ton, while the demand at £3 10s. per ton is greater than the supply.

ON THE

IDENTITY OF LIGHT AND RADIANT HEAT.[*]

By Professor TYNDALL, LL.D., F.R.S.

WHETHER we regard its achievements in the past, or its promise and tendency in the future, all that we know of physical science—every bent and bias which we receive from its pursuit—tends to confirm the dictum of the poet regarding this universe:—

> "All are but parts of one stupendous whole.
> Whose body Nature is."[†]

If I halt here, and omit the next clause of the couplet, it is not because physical science has arrived at any conclusion hostile to that clause, at all events in its profoundest signification, but simply because what the poet goes on to affirm lies outside the sphere of science. We, as physical students, have to do with "Nature" only, and our view of nature could not be more happily expressed than by the figure employed by the poet. For our vocation, and the delight and discipline that it confers, do not consist in the registration of unrelated facts and phenomena; but in the searching out and discovery of relationship in a system, whose parts we hold to be as closely and definitely related to each other as are the various organs and functions of the living body itself.

It was this spirit of search, this capacity and desire, developed amid natural agencies, to detect the lines of connection between these agencies, that gave for a time such keen interest to the discussion, whether light and heat were essentially different things, or whether a substantial identity subsisted between them. It is not so very many years since that most excellent experimenter and philosophical inquirer, Melloni, isolated from a solar beam a brilliant light, and finding it incompetent to affect his most sensitive thermoscopic apparatus, concluded that light and heat were essentially distinct. But in drawing this conclusion, Melloni forgot that he was implicitly dealing with an instrument of almost infinitely greater delicacy than his thermoscopic apparatus; he forgot that the human eye, and the consciousness connected with the eye, are capable of being vividly excited by an amount of force which, when translated into heat, might defy all the thermometers in the world to detect it. Melloni himself subsequently modified his conclusion.

It is not so very long since the late Princpal Forbes was eagerly engaged in establishing the important point that radiant heat, like light, is capable of being polarised. Since that time Knoblauch, Foucault, Fizeau, and Seebeck have applied their refined experimental skill to this question of identity; and those excellent investigators De la Provostaye and Desains, pushed the analogy between light and heat so far as to prove that the magnetisation of a ray of light, in Faraday's sense of the term, has its parallel in the magnetisation of a ray of heat.

It was, however, in their private cabinets that these experimenters obtained their results, which were in most cases so small as to require attention on the part of a skilled observer to detect them. But science grows, and our experimental means argument as our knowledge expands. Recent discoveries and improvements will, I trust, enable me to make evident to you effects which have been hitherto confined to far more limited circles; some of which, indeed, have only been seen by the observers who first noticed and described them. And if those accidents which often hold sway over lecture experiments of a delicate character should prove favourable, we may be able to push the subject a hair's breadth beyond the limits which observation has hitherto assigned to it.

Heat is presented to us in two aspects: sometimes associated with ordinary matter, through which it creeps by the process of conduction; sometimes not associated with ordinary matter, but, like light, flying through space with immense velocity. In this latter form it is called *radiant heat*. Radiant heat obviously and palpably comes to us from the sun, but here it is entangled with light. Let me, in the first place, endeavour to unravel this entanglement.

When white light is refracted, it is unravelled, and the spectrum is produced. A spectrum of the electric light was thrown upon a screen; and red, green, and black ribbons about an inch wide were successively moved along it. The red placed in the red light appeared a brilliant red; when moved into the green it became black. In like manner the green ribbon moved from the green, where it shone vividly green, into the red, became an intense black. The black ribbon was black in every part of the spectrum.

Now the red ribbon is not heated in red, and the green is not heated in green; but red is heated in green, and green in red. We have heating only where we have absorption; and the heat generated is the equivalent of the light absorbed. Black absorbs all the rays of light, hence, indeed, its blackness; and if it could speak, it might tell us the warmth of every colour. But warmth exists outside the colours. Beyond the red, where nothing is seen, the force acting on the retina is far greater than when the eye is plunged in the red. The objective here is entirely out of proportion to the subjective.

The existence of this heat was thus proved. All the colours but the red were cut off by a red glass, and with a diaphragm having a circular opening, a well-defined red circle was produced. This was refracted by a prism, still remaining a circle. A thermo-pile with its face towards

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[*] Read before the Royal Institution of Great Britain, February 2, 1872.

[†] "All are but parts of one stupendous whole,
Whose body Nature is, and God the soul."
POPE'S "Essay on Man," Epistle I., line 267.

the lamp was then caused to approach the path of the beam. It would have been seen by its shadow on the screen if the light had been at all invaded; but with a considerable interval between the pile and the light, a large deflection of the galvanometer testified to the presence of heat beyond the luminous circle. An opaque solution[*] was substituted for the red glass. A circle remained, but it was an invisible circle of radiant heat instead of a circle of light, and the needle of the galvanometer did not fall, though the visible image had vanished.

Thus, as regards refraction, we have radiant heat behaving like light. And now for reflexion. A horizontal beam of light was reflected upwards by a plane mirror, and when the light was cut off by the introduction of the opaque cell, a powerful beam of reflected heat was proved still to remain. The luminous beam was then *totally reflected* by a prism to a horizontal direction; the light was again cut off, and a powerful deflection of the galvanometer needle was obtained by the residual heat-beam. Thus, in respect to common and total reflexion the behaviour of light and heat is the same.

The action of lenses on light and heat was then demonstrated, the invisible heat-rays being brought to a focus as readily as the rays of light.

A beam of light was then made to strike a concave mirror, and at the focus, which was strikingly visible in the dust of the room, the thermo-pile was placed, having its face covered. The light being cut off by the dark cell, and the covering screen drawn away, the needle of the galvanometer at once flew to its stops.

Double refraction by Iceland spar was next described and explained. It was illustrated by passing through the spar a circular beam of light, which, on the screen, gave two images. The places on the screen where these two images fell were marked, and the light was cut off by the iodine cell. On introducing the thermo-pile with its face towards the lamp, when it occupied the position of either light-image, a deflection of the needle was obtained. Of the two images, one is the ordinary, the other the extraordinary. Is the same true of the heat? Placing the pile in the place of the ordinary image, cutting off the light, and turning the spar, the deflection of the needle remained unchanged; but when the spar was turned round, while the pile occupied the place of the extraordinary image, the needle instantly fell. Why? Removing the dark cell and rotating the spar, the extraordinary light-image was seen to rotate round the ordinary one, which remained fixed. The heat-beam did the same and thus quitted the pile. Here, then, we prove that the heat-beam also has its ordinary and extraordinary image. This, it was believed, was the first time the effect had been obtained with purely invisible heat. Knoblauch had demonstrated the double refraction of heat, using the total beam, luminous and non-luminous, of the sun.

Some of the phenomena of polarisation were next touched on. Light is propagated by the undulations of an etherial medium, the direction of vibration being perpendicular to the direction of propagation. A crystal of tourmaline has the property of quenching all vibrations except those which are parallel to the axis of the crystal; hence, a plate of tourmaline cut parallel to the axis will allow all vibrations in that direction to pass through it, but will stop all others. A beam of light which has passed through one plate of tourmaline is, therefore, unable to pass through another placed transversely to it, whereas, if the axes are parallel, the light is but little dimmed by the second plate. The black space due to the superposition of the crossed plates of tourmaline was shown, as also the abolition of the darkness by a thin film of mica introduced between the plates.

A beam with all its vibrations reduced to the same plane is called a beam of *plane polarised light*.

The two beams emergent from double-refracting spar are thus polarised. Nicol got rid of one. He cut a parallelopiped of spar into two by a very oblique section, polished the two surfaces, and united them by Canada balsam. The ordinary or more powerfully refracted ray, at the surface of the balsam is, in consequence of its obliquity, totally reflected, and the extraordinary ray passes on alone. In this way we obtain an intense beam of polarised light.

A beam of light was sent through two large Nicol prisms, and shown to be entirely extinguished when the principal sections of the prisms crossed each other. The introduction of a plate of mica between them caused, as in the case of the crossed tourmalines, the instant reappearance of the light. The opaque cell was then placed in front of the lamp, all visible rays being thus intercepted. The thermo-pile was next placed so as to receive the beam after leaving the second Nicol prism. Causing one of the crossed prisms to rotate, a path was opened for the heat exactly as for the light, the deflection of the needle speedily bearing witness to the fact. The prisms being again crossed, the heat-beam was again quenched; but as in the case of light, the introduction of a piece of mica restored the heat and caused a large deflection of the galvanometer.

Faraday's great experiment was next performed. A beam of light, polarised by one Nicol's prism, was made to pass through a piece of heavy glass placed between the perforated poles of an electro-magnet, and afterwards through another Nicol, so placed that the beam was extinguished. When the magnet was excited the plane of polarisation was caused to rotate, and a luminous image flashed instantly out upon the scene. The effect of magnetisation is greatly augmented by adopting the device of MM. De la Provostaye and Desains, of causing the principal sections of the Nicol's prism to enclose, not a right angle, but an angle of 45°. This was done, the heat falling on the pile being neutralised by the method of compensation. On sending a current round the magnet a considerable deflection of the needle was obtained, the direction of the deflection depending on that of the magnetising current.

De la Provostaye and Desains thus obtained with luminous solar heat a deflection of 2° or 3°. With the iodine filter and the electric lamp a deflection equivalent to 150 of the lower degrees of the galvanometer was obtained from purely non-luminous heat.

THE SUCCESSIVE ACTION OF SODIUM AND IODIDE OF ETHYL ON ACETIC ETHER

CRITICALLY EXAMINED AND INTERPRETED ON THE PRINCIPLES OF THE TYPO-NUCLEUS THEORY.

By OTTO RICHTER, Ph.D.

(Continued from p. 211.)

Part II.

On the Genetic Relations and Chemical Constitution of that Series of Chemical Compounds and Derivatives which emanate from Mr. Wanklyn's Experiments.

In taking notes of this case, and while Frankland's report was still fresh in my memory, I could not help being struck with Wanklyn's sweeping and emphatic statement, that little or no hydrogen gas was emitted during the reaction. This perplexing but well-authenticated fact appeared to me so full of weight and significance as to rouse in me the suspicion that the two processes differed materially from each other in their *modus operandi*. It was in one of those lucky moments which, like angels' visits, are few and far between, and while I was contemplating my formula for acetic ether that the bright idea flashed across my mind, to which these lines may be said to owe their existence. I conceived that in the conditions prescribed by Wanklyn no hydrogen gas could be evolved, because the action of the sodium on the acetic ether was

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[*] Iodine in bisulphide of carbon.

directed entirely and exclusively towards the oxygen of the oxalic acid, which plays here the part of a principal, while in the conditions prescribed by Frankland abundance of hydrogen gas should be evolved, because the action of the sodium on the acetic ether was directed entirely and exclusively towards the hydrogen of the methyl, which plays here the part of an adjunct. By availing myself of this very reasonable hypothesis, and elaborating it in accordance with the principles of the "typo-nucleus" theory, I am now able, I flatter myself, of submitting a perfectly intelligible, consistent, and comprehensive analysis of the various molecular changes which accompany the formation of the substances we are about to consider.

Mr. Wanklyn, under the natural, but erroneous, impression that Professor Frankland had along been experimenting with impure materials, and that his somewhat exaggerated torrents of hydrogen were really due to the action of sodium on certain quantities of water and alcohol, with which the acetic ether was contaminated, or which had been engendered during the reaction, and finding that an elementary analysis of his compounds led to the same empirical formulæ with those of Frankland, committed the very pardonable mistake of insisting on their chemical identity. My present object is to show on theoretical grounds that the two sets of compounds are not identical, but only isomeric, and I shall feel exceedingly obliged to those chemists who have been working on this subject to test on practical grounds the soundness and validity of my mode of reasoning. For this purpose, I shall select the following passage from one of Wanklyn's numerous contributions to this case. I shall quote it verbatim, but take the liberty of doubling his empirical formulæ. He says—

"With reference to Frankland's and Duppa's paper in the London *Philosophical Transactions*, it will be found that the products described by them as obtained from the 'wax-like mass' and iodide of ethyl are the following:—(*a*) $H_{28}C_{32}O_{12}$, a liquid boiling at 195° C.; (*b*) $H_{36}C_{40}O_{12}$, a liquid boiling at 212° C.; butyric ether, caproic ether, some unacted upon acetic ether, and considerable quantities of common ethylic ether. I have already shown that the direct products of the action of sodium on acetic ether are ethylate of sodium and sodium triacetyl. Nothing else seems to be produced directly, but the excess of acetic ether, which is necessarily taken, acts on some of the ethylate of sodium, producing alcohol and acetate of ethylen-sodium in the manner described by me on a former occasion. We have, therefore, in the wax-like mass, got by prolonging the action of sodium on acetic ether—Ethylate of sodium, $H_{10}Na_2C_8O_4$; sodium-triacetyl, $H_{18}Na_2C_{24}O_{12}$; acetate of ethylen-sodium, $H_{14}Na_2C_{16}O_8$; and alcohol, $H_{12}C_8O_4$. On the first three iodide of ethyl acts, giving iodide of sodium and organic liquids. From the ethylate of sodium comes the common ether. From the sodium-triacetyl comes ethyl-triacetyl, which is (*a*), having been got by Geuther from the pure sodium-triacetyl. From isolated acetate of ethylen-sodium and iodide of ethyl I have recently obtained liquid (*b*), thus:

$$2H_{14}Na_2C_{16}O_8 + 2H_{10}C_8I_2 =$$
$$= 2Na_2I_2 + H_{12}C_8O_4 + H_{36}C_{40}O_{12}.$$

The liquid prepared by me boiled at 212° C., and gave carbonate of baryta with baryta-water, and was identical with Frankland's (*b*). By the action of liquid (*a*) upon ethylate of sodium, Geuther has recently shown that butyric ether is produced thus:

$$H_{28}C_{32}O_{12} + H_{10}Na_2C_8O_4 = \text{acetate of ethylen-sodium},$$
$$H_{14}Na_2C_{16}O_8 + \text{butyric ether, } H_{24}C_{24}O_8.$$

Finally, I predict that liquid (*b*) will give—

$$H_{36}C_{40}O_{12} + H_{10}Na_2C_8O_4 = H_{14}Na_2C_{16}O_8 + \text{caproic ether,}$$
$$H_{32}C_{32}O_8.\text{''}$$

It is meet that I should likewise advert to some other experiments, which were devised by Wanklyn, with the view of demonstrating the total absence of hydrogen gas during the action of sodium upon certain species of compound ethers. This was proved in the case of butyric, valeric, and benzoic ether, and it must have given our esteemed colleague no small satisfaction when he was informed by Frankland himself (*Proceedings of the Royal Society*) that sodium dissolves in valeric ether under ordinary atmospheric pressure without evolution of hydrogen gas. "This reaction," adds the learned Professor, "whatever its nature may be, which thus proceeds readily with ethylic valerate, can scarcely be impossible with its homologue, acetic ether, and it is probable that this reaction goes on side by side with those we have described in our memoir; but when the pressure is moderate, those changes chiefly take place which involve the disengagement of hydrogen, whilst under great pressure the reaction observed by Mr. Wanklyn comes into prominence." Thanks to these seasonable, and, to the writer, highly honourable, concessions (honourable, because the hand that committed them to paper was by the same act offering the olive branch of peace—not, indeed, as a token of tame surrender, but as a proud testimony that the love of truth was overruling every other consideration), I was not long in compounding a proper diagnosis of the whole case. This I accomplished by applying my peculiar mode of reasoning to the simple equation which Wanklyn gives in recording the results of the action of sodium on valeric ether. I had thus the satisfaction of discovering what, in musical language, might be called the key-note, in which this chemical tune and all its variations are composed. The only products of this reaction are ethylate of sodium and valerite of soda, according to the equation—

$$\frac{2H_4C_4\,;\,H_2O_2.}{2H_9C_8\,;\,2C_2O_3} + 2Na_2 = \frac{Na_2O_2.}{2H_4C_4\,;\,H_2O_2} + \frac{Na_2O_2.}{2H_9C_8\,;\,2C_2O},$$

clearly showing that the $2Na_2$ are first of all oxidised into $2Na_2O_2$ at the expense of the oxalic acid, which is thereby reduced to oxalous acid, and which, together with its butyl-adjunct, constitutes the valerous acid, $2H_9C_8\,;\,2C_2O$. In the second stage, the newly-formed soda, $Na_2O_2.Na_2O_2$, acts on the valerous ether, when, by the process of double decomposition, the two basic nuclei, Na_2 and $2H_4C_4\,;\,H_2$, interchange places, with formation of ethylate of sodium and valerite of soda. With this valuable key in our possession, let us now analyse the equation which Wanklyn proposes in order to account for the fact that nothing else is obtained in his experiment than sodium-triacetyl and ethylate of sodium. From this equation, of the correctness of which I myself am thoroughly convinced, it would appear that four sodium molecules are matched against three molecules of acetic ether. Accordingly we have—

$$3\left(\frac{2H_4C_4\,;\,H_2O_2.}{2H_3C_2\,;\,2C_2O_3}\right) + 4Na_2 = \text{sodium-triacetyl:}$$
$$\frac{H_2O_2. \qquad H_2O_2. \qquad Na_2O_2.}{2H_2C_4\,;\,H_2O_2 : 2C_4\,;\,H_2O_2 : 2H_3C_2\,;\,2C_2O} + 3\left(\frac{Na_2O_2.}{2H_4C_4\,;\,H_2O_2}\right),$$

and the two first stages of the process are completely analogous to those which accompany the action of sodium on valeric ether, the resulting products being two molecules of acetite of soda and two molecules of ethylate of sodium. The third stage I hold to be marked by the re-solution of the third co-operating molecule of acetic ether into ethylic alcohol, and the hypothetical deacetylic alcohol (see p. 210), which instantly unites with one of the two newly-formed molecules of acetite of soda, with production of the complex molecule—

$$\frac{H_2O_2. \qquad Na_2O_2.}{2C_4\,;\,H_2O_2 : 2H_3C_2\,;\,2C_2O}$$

corresponding to the unknown aceton-carbonite (diacetite) of soda. In the fourth stage, an interchange of basic nuclei takes place between the newly-formed ethylic alcohol and the second molecule of acetite of soda with production of acetite of water, and the third molecule of ethylate of sodium. In the fifth and last stage, this acetite of water, after merging into the isomeric deethylic alcohol, combines under that form with the before-mentioned aceton-carbonite of soda, yielding thereby, as the final product of the reaction, the deethaceton-carbonite of soda, which I hold to be identical with Wanklyn's sodium-triacetyl. Wanklyn, on the other hand, who is still reasoning and writing under the spell of his polyatomic sodium theory, imagines that, when his sodium-triacetyl is treated with acetic or hydrochloric acid, it becomes by no means converted into hydrogen-triacetyl, but into an isomeric body which he is pleased to call acetate of acetylinated ethyl. Experiment alone can decide between his and my mode of arguing, and since, according to my formula, this substance ought to possess the well-pronounced chemical properties of a triatomic compound, it would not be difficult for Mr. Wanklyn to determine this point at his leisure. I may here mention that, in consideration of its origin from acetic acid, and to record the alcoholic nature of its two adjuncts, I have registered the corresponding water-salt (Wanklyn's hydrogen-triacetyl) under the term acetalconite of water, and the water-salt which corresponds to the before-mentioned aceton-carbonite of soda, from its being a homologue of the pyruvite of water, under the term acepyruvite of water (*vide* table of genetically-related water-salts).

Having now submitted to the reader what I believe to be a substantially correct analysis of the chemical process of which sodium-triacetyl and ethylate of sodium are proved to be the only products, I shall remark in the next place upon the pretended identity of Wanklyn's derivatives with those of Frankland. "When sodium-triacetyl," says our learned expositor in the above-quoted passage, "is acted upon by iodide of ethyl, there is formed ethyl-triacetyl, which is (*a*), having been got by Geuther from pure sodium-triacetyl." This is an important statement, for it shows that the substance with which Geuther performed his experiments, and to which he applies the name "sodiodiacetic ether," is regarded by Wanklyn as identical with his own sodium-triacetyl. But in what precedes I think I have satisfactorily demonstrated that Geuther's compound, no matter whether it was obtained by Frankland's method or by the action of ethylate of sodium on acetic ether, is identical with Frankland's sodaceton-carbonic ether, and therefore, and notwithstanding the congruence of their empirical formulæ, constitutionally distinct from Wanklyn's sodium-triacetyl. This being understood, a mere glance at their formulæ will convince the reader that the displacement of the sodium by ethyl can, in the corresponding derivatives of ethaceton-carbonic ether and ethyl-triacetyl, give birth to a couple of isomerides only. Wanklyn further alleges that he has obtained the compound (*b*), and he rests his proof of its identity with Frankland's diethaceton-carbonic ether on the fact that the liquid showed the same boiling-point and gave carbonate of baryta with baryta water, while he is ominously silent concerning the other products of the reaction. Without entering into details, I shall simply observe that the circumstance of Frankland's compound being derived from the action of two molecules of iodide of ethyl on one molecule of disodaceton-carbonic ether, whereas Wanklyn's compound is derived from the action of two molecules of iodide of ethyl on two molecules of acetate of ethylen-sodium (sodacetic ether), this circumstance, I say, trivial though it may appear at first sight, does not augur well for the hypothesis of their chemical identity. I am unable to tell whether Wanklyn has succeeded in isolating the caproic ether, which, according to his view, ought to be obtainable from liquid (*b*) by the same method which enabled Geuther to produce butyric ether, viz., by the action of liquid (*a*) on ethylate of sodium. The reader will bear in mind that the liquid under consideration is the ethaceton-carbonic ether of Frankland; consequently the butyric ether here spoken of, and which remains after the removal of the colligated deacetylic alcohol and its conversion into sodacetic ether with the aid of the ethylate of sodium, must be identical with the ethacetic ether of that chemist. Let us now inquire into the molecular structure of the butyric ether, which Wanklyn obtained by applying Geuther's method to his own liquid (*a*), and which he is now pleased to call "butyrate of acetylinated ethyl," in preference to the original and more appropriate term, "ethyl-triacetyl. The *rationale* of the process is precisely as in the former case, but a comparison of the two formulæ—

$$\frac{2H_4C_4 ; H_2O_2}{2(H_6C_4 : H\ C_2) ; 2C_2O_3} \text{ and } \frac{H_2O_2. \qquad 2H_4C_4 ; H_2O_2.}{2H_2C_4 ; H_2O_2 : 2H_3C_2 ; 2C_2O}$$

plainly shows that Geuther's butyric ether and Wanklyn's butyric ether stand to each other in the relation of isomeric bodies only. And here I cannot help expressing my surprise that Mr. Wanklyn should never have drawn in question the identity of these two species of butyric ether, while he freely admits the non-identity of their corresponding sodium compounds. In proof of this, I take the liberty of quoting a sentence which occurs in his paper "On the Salts of Acetylinated Ethyl." He says—"The third compound (caproate of acetylinated ethyl) is produced by the action of iodide of ethyl on acetate of ethylen-sodium (the *isomer* of butyrate of soda, recently described by me, which yields alcohol and acetate of soda when treated with water)." I must not forget to mention that, by heating a mixture of one molecule of ethdiacetic ether, one molecule of acetic ether, and one molecule of ethylate of sodium in sealed tubes, Geuther actually succeeded in obtaining two molecules of butyric ether for every one of ethdiacetic ether, a molecule of acetate of soda being formed at the same time. It is clear, therefore, that the first stage of the process consists in the production of one molecule of butyric ether and one molecule of sodacetic ether, which in the second stage, by exchanging its sodium for the ethyl of the accessory acetic ether, gives rise to another molecule of butyric ether and acetate of soda. Geuther's experiment is highly interesting in this respect also, that it seems to afford yet another instance of the modifying effects of external pressure upon the results of the reaction, for in the formation of Frankland's sodaceton-carbonic ether, which takes place at the ordinary atmospheric pressure, the two conflicting molecules of acetic ether and sodacetic ether resolve themselves into alcohol and sodaceton-carbonic ether; while in the formation of Geuther's butyric ether, which takes place under high pressure, the two conflicting molecules of acetic ether and sodacetic ether resolve themselves into butyric ether and acetate of soda. Finally, as regards the caproic ether, which Wanklyn expects to obtain from his liquid (*b*) with the aid of ethylate of sodium, I feel convinced that it is Frankland who, in his liquid (*b*), holds the right substance for this experiment, because my formula of the diethaceton-carbonic ether plainly shows that, after the removal of the colligated deacetylic alcohol, and its conversion into sodacetic ether under the influence of the ethylate of sodium, the remaining portion of the molecule must be diethacetic or isocaproic ether, while, under the same treatment, the liquid (*b*) of Wanklyn ought to resolve itself into a molecule of ethacetic ether and a molecule of sodethacetic ether. I shall wait patiently for the experimental answer to these prognostications; but whether my theoretical deductions be confirmed or contradicted, it is certain that our charming science will always be the gainer in the end. With these observations I shall now proceed to the third and last part.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 2nd, 1872.

Dr. Frankland, F.R.S., President, in the Chair.

When the minutes of the previous meeting had been read and confirmed, Messrs. Charles Thomas, E. H. Morton, Thomas Tyrer, Mark Finch, and G. Packer were formally admitted Fellows of the Society.

The following names were read for the first time:—Messrs. George Elliott Barker, H. Smith, Richard Hayton Davis, Richard Weaver, and Francis Henry de Rheims, jun.

For the third time—Messrs. Richard Anderson, and George Cordwent, M.D., who were then balloted for and duly elected.

The President then called on Mr. E. Riley to deliver his lecture on "*The Manufacture of Iron and Steel.*"

The author, in his lecture, confined himself chiefly to the influence of the elements associated with iron in the pig, and the part they play in the subsequent conversion of the pig- into wrought-iron and steel; considering the present system of smelting in blast-furnaces to be so simple that it was difficult to see how any process can compete with it except in exceptional cases.

Although in certain districts there is not much variation in the pig made, the same ore and fuel being constantly used, yet in others, as South Wales, and Staffordshire, so many varieties of ore are employed that pig of all descriptions is produced. From the results of analyses of samples of Yorkshire cold-blast pig (No. 1 to 6 iron) from the same works, it would appear that, whilst the phosphorus is almost constant in all the kinds, about 0·64 per cent; the quantity of sulphur decreases, and that of the silicon increases with the number. It is probable that the differences in the amount of sulphur present would explain the differences in the quality of the pig, for it is certain that sulphur makes grey iron into white. At the same time, however, the different numbers in grey iron may be produced by differences in the rate of cooling. The author criticised Mr. Bell's process for determining sulphur in iron, and gave details of the one he had himself employed. On examining the pigs of which the best wrought-iron is made, they will be found to contain silicon and phosphorus, Swedish iron, which contains no phosphorus and but little silicon, when used by itself giving a red-short iron. Hæmatite pig is special in its character on account of its freedom from phosphorus and its adaptability for the Bessemer process, although the amount of silicon present is not unfrequently as high as 4 or 5 per cent.

The chief constituents of pig-iron are carbon, silicon, sulphur, phosphorus, and manganese, traces of copper and titanium (the latter only in grey iron), frequently nickel and cobalt, and occasionally vanadium and arsenic. The percentage of carbon in pig-iron varies from 3 to 4 per cent, but the question as to whether it forms any definite compound with iron is open to great doubt. Mr. Snelus has shown that, by sifting out the finer portions from the borings of Middlesbro' pig, a material could be obtained containing 7·0 per cent carbon, and by elutriation one containing more than 41 per cent. Sulphur seems always to be derived from the sulphide of iron that may be present in the fuel or ore, but from some experiments it would appear that an excess of lime may act on the sulphide of iron in the coke and convert it into sulphide of lime and metallic iron. Silicon is always present to a greater or less extent in iron, and the author has succeded in obtaining an alloy of silicon and iron containing as much as 21·7 per cent of the former. It is quite insoluble in hydrochloric acid, and only slightly acted on by *aqua regia*. With respect to phosphorus, practically speaking, all that is present in the ore and in the fuel used passes into the pig-iron.

After some remarks on the comparatively little value of titanium as an ingredient in pig-iron, the speaker discussed the quality and composition of the fuel employed in smelting, and then passed on to the process of refining. The time required for refining iron seems to depend on the amount of silicon present in the pig, much of it being separated during the operation and also some sulphur and phosphorus and a little carbon. The process of puddling was then described, and the merits of the various machines invented for that purpose discussed, with especial reference to the results obtained with that of Mr. Danks. The great advantage of machine puddling is the uniform quality of the wrought-iron made. In conclusion, the author made some remarks on steel, particularly with regard to the occurrence of silicon in it. This valuable and elaborate memoir was copiously illustrated with analyses.

The President said the Society was much indebted to Mr. Riley for his interesting and exhaustive lecture containing an account of his long and extensive series of researches. There were several points of interest which he hoped would give rise to discussion, amongst which he might mention the very large percentage of carbon, or, rather, material containing carbon, which could be separated mechanically from borings of iron by sifting or washing. He had felt much interested in the action of a large excess of lime in withdrawing a portion of the sulphur from iron, but most certainly should not have anticipated that an ore containing a large percentage of baric sulphate should have reduced this to sulphide without any of the sulphur passing into the iron. The concluding part of the discourse, giving the author's testimony to the success of machine puddling, was very interesting.

Mr. W. Mattieu Williams remarked that he was afraid the lecturer could only have seen his paper on burnt iron and steel in abstract. He had found on taking a number of samples of iron borings and treating them with dilute acid in the manner he had described, he could tell those which were burnt from those which were unburnt. In the former case the liquid became of a very dark colour at first—whilst hydrogen was rapidly given off—from the minute dark particles suspended in the liquid, rendering it turbid. Re-heating and re-rolling improves iron only to a certain extent; after that point it becomes burnt, which may readily be detected by black particles making their appearance in the previously bright silky fracture. Although he quite agreed with Mr. Riley as to the small value of an alloy of titanium with iron, he believed titanic acid to be useful during the process of manufacture.

Dr. Wright said, in reference to Mr. Bell's experiments on the Cleveland pig, in which he had assisted, that it was found that some white pigs on solution left behind a larger quantity of carbon than some grey pigs; he believed the carbon existed in pig-iron in a state similar to that of a solidified solution. When the carbon is able to crystallise out readily, it forms grey pig, and when with difficulty white; the quantity of carbon carried off as hydrocarbons on solution depending on the size of the particles of carbon, the smaller ones being taken up more readily by the hydrogen. Mr. Bell had found that pure carbonic oxide passed over iron oxide at a white heat does not completely remove all the oxygen, so that he believed the completion of the reduction in the blast-furnace to be effected by the potassium cyanide in the lower part of the furnace.

Dr. Williamson remarked that he had gathered from Mr. Riley's interesting communication that he seemed to think that the blast-furnace was likely to remain the basis of our operations: he could not conceive that a means so grossly faulty could continue to be so. The process was so very rough and crude, not only adding carbon to render the iron more fusible, but at the same time introducing injurious ingredients like sulphur and phosphorus.

Mr. Riley, in reply, said that Mr. Williams had scarcely answered his objections; he had carefully repeated his process, and his assistant had also tried it, but they had both failed to observe the darkening described by him. He quite agreed with Professor Williamson that the blast-furnace was a very rude and unscientific apparatus; but when we consider the enormous amount of material operated on which has to be converted into iron at a labour cost of two or three shillings per ton, it will be evident that all improvements should have the object of saving labour. It was quite possible to produce almost chemically pure iron, but only at considerable cost.

The PRESIDENT, after calling on the Fellows present to pass a vote of thanks to Mr. Riley by acclamation, adjourned the meeting until Thursday, May 16th, for which eight communications are announced, including a letter from M. Maumené of Paris, a paper on "Chinoline and Leucoline," by C. Greville Williams, and "New Tests for some Organic Fluids," by Dr. Wanklyn.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 2nd, 1872.

J. P. JOULE, D.C.L., LL.D., F.R.S., Vice-President, in the Chair.

MR. S. C. TRAPP and MR. G. C. LOWE were appointed Auditors of the Treasurer's Accounts.

Ordinary Meeting, April 16th, 1872.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

Among the donations announced were a number of MS. Journals and Papers of the late Mr. Thomas Heelis, F.R.A.S., presented by Dr. Crompton and Mr. John Heelis. On the motion of Mr. Baxendell, seconded by Professor Reynolds, it was unanimously resolved that the thanks of the Society be given to Dr. Crompton and Mr. John Heelis for their valuable donations.

The Rev. Joseph Freeston was elected an Ordinary Member of the Society.

The President said that too much attention could not be called to the drains connecting dwelling-houses with main sewers. Of course in all modern houses it is supposed that such communications are effectually trapped, so as to prevent sewage gases gaining access to the houses. However, it is to be feared many of the so-called traps are traps to catch and transmit disease, and not to stop it. He had himself, at his residence in Crumpsall, a drain from a sink-stone communicating with the sewer, and for the last few years it had acted moderately well, except during sudden falls of the barometer, when smells would get into the house in spite of the traps. During the past summer a servant having found some sewage gases escaping into the yard, from the eyes communicating with the sewer, trapped them. When he (the President) returned home last autumn he found the yard quite free from smells, but his house full of them, the traps in the yard having forced them inwards. No time was lost in cutting the pipes communicating with the sewer, so as to allow the refuse water to discharge itself into the open air and fall into a stench trap communicating with the sewer. This has effectually stopped all smells from sewage gases entering his house. The connection of house drains with main sewers is no doubt a fertile source of disease, and in some cases even the means of transmitting it from house to house.

Mr. Richard Weaver, Sanitary Engineer and Chemist, 20, Nile Street, Leicester, had lately informed him that he (Mr. Weaver) had some seven months ago visited Sunderland, then suffering from a smart attack of small-pox. The sanitary officer and chairman of the Health Committee stated that the sewers had excellent ventilation. This excellent ventilation consisted of six openings into chimney stacks, for the most part at the lower extremities of sewers. Now, until the fallacy was pointed out, the responsible authorities considered six openings, promiscuously selected, sufficient for the ventilation of probably fifty miles of sewers and drains, many of them on very steep ground, and the tide flowing up twice in twenty-four hours.

Mr. Weaver found, as he expected, the epidemic most severe on the outskirts and suburbs, in places of fine situation, and open country. Here was street upon street where the sewage had spared scarcely a house, and in almost all was a more or less powerful odour of sewer gas. Now this was remarkable, and the explanation he discovered, after some trouble, although the authorities could tell him nothing of it, that many of these streets had a special sewer laid down in front of the houses, with a branch run under the floors of each building, which were filled up with ashes, and the pipe left open for the purpose of removing sub-soil water! The lower end of each sub-soil sewer joined the mains, contact being supposed to be broken by a syphon, but as these were never looked at from the day of being laid, and as no water flowed from the cellars, in dry weather the syphon speedily became untrapped, and an uninterrupted flow of gas proceeded into the houses.

A very good proof of this being the mode of propagation of the disease was furnished in one-half of a street, that is on one side of it, being without any drainage whatever, and had not a single case of small-pox. Now here the privies and slops overflowed the yard and lane, and the stench was most unbearable, yet this side escaped. Opposite, all was much cleaner to the eye, but the sewage gas was within the houses, and so was the epidemic. So much for our vaunted sanitation!

Now assuming this statement of Mr. Weaver's to be true, it appears that in some cases the germs or particles of disease are communicated by drains and sewers from house to house, and that untrapped or badly trapped ones are far worse than having no drains at all.

"*On a new Theory explanatory of the Phenomena exhibited by Comets.*" By DAVID WINSTANLEY, Esq.

An explanation of the phenomena exhibited by cometary bodies seems to have been generally sought for amongst the most hidden of Nature's operations; indeed inventors of theories would appear to have taken it as an axiom that the extraordinary and imposing aspects which are frequently presented by the heavenly bodies in question can only be explained by the operation of natural laws which here we do not know, by the existence of chemical substances which here we have not got, or by the presence elsewhere of conditions which here we do not find. To me it does not seem that the causes of cometary appearances are of necessity deeply hidden, nor that the invention of new natural laws, new chemical substances, or new conditions of matter, offers us a more philosophical or even a more handy means of accounting for those appearances than without them we already possess.

It is undoubtedly in the presence and the configuration of their tails that we recognise the greatest visible differences from the planets which comets exhibit. But these visible differences, curious and interesting as they are when present, are sometimes wholly wanting, ofttimes merely rudimentary, and when existing are continually altering their dimensions and their forms. There are, however, two points in which comets constantly differ from the other members of our system, and these points are to be found in the smallness of their mass and the eccentricity of their orbital paths. It is in these ever-present points of dissimilarity that I apprehend we shall find the cause of those visible, those varying, and those incidental differences from the planets, with which the term comet has become inseparably associated. It has not been observed that the smallest comets are most remarkable for their phenomena or their aspects. On the contrary, the larger bodies of the class have always presented the most striking appearances, whence I infer that though these appearances are beheld only in connection with bodies of comparatively trivial mass, yet that insignificance of mass is not the primary element in the formation of the phenomena under consideration. The eccentricity of their orbits, however, having been a noticeable feature in connection with all the most remarkable comets, it is in this particular, and the circumstances which accompany it, that I think the clue will be found to a solution of the enigma of their aspects. The most obvious difference from the planets which we might expect in the case of a comet on account of the smallness of its mass would be the feeble coercion of the elastic power of its gaseous parts, and the consequent voluminous development of its atmosphere, whilst the eccentricity of its orbit would undoubtedly give rise to enormous changes in temperature of the particles composing it. It is in this extension of atmosphere, and in the suddenness and violence of these thermal changes, that I think it possible to find an explanation of almost every one of those appearances which are peculiar to comets as the ordinary and every day phenomena of their meteorology.

Suppose, for instance, we have a planetary body composed of such materials as the earth is made of, and as the spectroscope indicates as entering into the composition of the sun,—and suppose this planetary body to be in comparison with our globe extremely small in mass, and located at such a distance from the sun as to be sensibly affected by his rays (say, for instance, within Saturn's orbit),—and suppose, further, that it is retained at that distance until such changes as would be produced by the temperature to which it is there subjected are fully realised; we should then have a central mass of more or less solid material, surrounded by an attenuated atmosphere of such substances as are gaseous at the particular temperature there prevailing, and under the particular pressure exercised by the gravitation of the central mass. Now let us suppose our planetary body to be moved to another position considerably nearer to the sun, and so subjected more largely to the influence of his rays; an augmentation of its atmosphere would immediately be commenced; materials non-volatilisable at its previous temperature would be raised into the gaseous form; the volume of its atmosphere would be increased, whilst the planet's coercive power over its elasticity would be diminished. But let us suppose our planetary body to be once more replaced in its former position, and subjected to the lesser of the two temperatures we have been considering; the solar heat will now no longer be able to maintain all that matter in the gaseous form which has been evaporated at the shorter of the two distances from the sun. A condensation will accordingly be commenced through a greater or less extent of the cometary atmosphere, and a more or less dense nebulous mass will surround the central stellar point. This nebulosity will be again evaporated into transparent gas upon the removal of the body it surrounds to its second position nearer to the sun. But the atmospheric condensation into cloud-like mist which follows the removal of our little planet from the influence of the solar rays would also result from the removal of those solar rays from that little planet, such, for instance, as would be caused by the interposition of one of the planets. Under *these* circumstances a precipitation of misty material would take place,—a precipitation which would, as before, be dissipated at the termination of the eclipse.

A comet, however, is not circumstanced as our hypothetical planet has been. It is not placed at some given distance from the sun and allowed to remain there until the maximum thermal effect has been produced, and then removed elsewhere. It is continually altering its distance from the sun, and, apart from any axial rotation it may have, is continually presenting a fresh aspect to the operation of the solar heat. Vapourised materials issue from its heated surface in jets like steam, and rise towards the sun into the cooler atmosphere above, where they lose a portion of their heat, become partially condensed, and form a canopy of cloud, which, when viewed from the side by the inhabitants of another planet, presents the appearance of a crescent with horns turned from the sun of a hemisphere or a sphere of nebulous matter, according to the amount and aggregation of the misty particles. As the comet approaches its perihelion this misty canopy is dissipated, as transparent gas, into the upper and surrounding regions of its atmosphere, by the ever-increasing power of the sun, whilst fresh jets of steam arise from the heated surface of the central mass, and replenish the stratum of clouds. It is not difficult to find an interpretation of the existence of a number of these cloudy strata floating in the comet's atmosphere, in concentric rings around its central mass, in the presence of atmospheric ingredients of different chemical constitution, or in supplies of vapour furnished from the same source, at different intervals of time, as indicated in the alternate violent action and total cessation of the steamy jets which have been observed to take place. But whilst all this is going on upon the anterior or sunward side of the comet, there is quite another state of affairs on the opposite side. There the planetary mass and its cloudy canopies project their shadows and their shades into a vast conoidal space beyond, a space in which total and partial eclipses of the sun prevail, where the influence of the solar rays is felt with mitigated force, and where, consequently, a misty precipitation is formed, which becomes illuminated in the penumbra by the direct rays of the partially eclipsed sun, and throughout its whole extent by the scattered beams which penetrate the bank of filmy clouds floating over the central planetary mass, and stretching away in a direction from the sun, forms that illuminated appendage known as the cometary tail.

It will be perceived, however, that though condensation would be commenced, where the temperature was sufficiently mitigated, throughout the whole of that conoidal space, darkened by the intervention of the planet and its clouds, yet, when once commenced, the inner particles of cloud being largely protected from further radiation by those external to them, the sum total of condensation would be almost confined to an annular space near the circumference of the shadow; in short, the misty cloud would have the form of a hollow cone, which would account for the frequently observed apparent division of the tail into two lateral branches, for this hollow envelope being oblique to the line of sight at its borders, a greater depth of illuminated matter would there be exposed to the eye.

As the comet proceeds along its path it will project a newer shadow at an angle from that which it has already cast, the mist formed in which latter will be dispelled by the unimpeded action of the solar rays, whilst another portion of the comet's atmosphere will suffer partial condensation, thus causing the formation of a new tail and the dissipation of the old one to take place simultaneously, and accounting for the enormous sweep which the tail makes round the sun in perihelio, in the manner of a rigid rod, and in seeming defiance of gravitation and all mechanical law.

The extent to which condensation in the cometary atmosphere will take place will obviously depend, amongst other things, on the difference of temperature within and without the shadow, and on the length of time during which that difference of temperature is allowed to operate. Now the further from the nucleus we go, the fainter and the more diffuse the shadow will become; and apart from this, as well as in consequence thereof, the less the difference of temperature within and without that shade, and the longer the time required to effect a condensation. Accordingly the axis of the conoidal envelope will lag behind the axis of the shadow, the more so as we recede from the nucleus, thus producing the observed convexity on the tail's orbital preceding side.

The further we are from the nucleus, however, and for the same reason, the longer will be the time required to evaporate the mist already precipitated, and the further, therefore, will be the point at which the mist is cleared from that at which it was condensed, thus accounting for the retrograde curvature of the posterior edge of the appendage, and for the excess of this curvature over that of the opposite side.

The angular separation of the front and rear edges of the tail will clearly be regulated, amongst other things, by the angular capacity of the shadow in which that tail is formed, which increases with the comet's proximity to the sun.

Accordingly we should expect this angular separation to be at its greatest in perihelio, which, as a matter of fact, has been observed to be the case. Particular attention was called to this phenomenon in the instance of Donati's comet in 1858, and beautiful plates illustrative of it are given in the 30th volume of the Astronomical Society's *Memoirs* by Prof. Challis and Mr. Warren De la Rue.

The fact that the maximum length and splendour of a comet's tail is attained not at, but after, the passage of the perihelion is only what we might reasonably expect, for, as we know, time is required in which to produce any physical change, and, consequently, that augmentation of the cometary atmosphere resulting from the heat received in perihelio must necessarily be produced some time after that heat has been received, and, therefore, after the perihelion passage.

The diminution in size which the nucleus of a comet undergoes as it approaches the sun, and the subsequent expansion which takes place as it recedes from it, a diminution and expansion which are contemporaneous with, but reversed in order to, the dilation and contraction of the tail, follow as a corrollary to the theory I have laid down, and seem to me strongly to indicate that the tail is really a material appendage of the comet, and not an effect produced by it upon any medium through which it may be supposed to move.

It may be said in objection to my theory that comets are not made up of such chemical substances as I have instanced in the case of the hypothetical planet, to which I would reply "Nor need they be." The theory in question only requires that they should be composed, at any rate in part, of materials evaporable by heat and whose vapours are condensable by cold, and this, I think, apart from being an almost self-evident proposition, the spectroscope has shown to be a fact in the instances of the small comets examined by its aid. It indicates, as I understand, the existence of heated gaseous matter about the nucleus, and of liquid or solid material in a state of infinitesimal division in the substance of the tail.

The six-tailed comet of 1744 will, I have no doubt, be pointed to as one whose phenommena it is difficult to explain in accordance with the theory I have advanced. I would ask those who feel disposed to raise this objection to examine the evidence upon which it is affirmed that the comet in question was really possessed of a multiple tail. To my own thinking, that evidence is so far from being conclusive that it would be premature to offer an explanation of the phenomenon before the appearance of another comet, unmistakably presenting the peculiarities attributed to that of 1744.

There are instances on reliable record in which comets have been known to present two tails curved in opposite directions, others in which the solitary appendage has shown no sign of curvature, and some in which two appendages have existed at the same time, but separated by a larger angle than seems consistent with the meteorological theory. These instances, however, form the small exception and not the rule, and may, moreover, be explained as merely the results of perspective.

I think I have now said sufficient to enable those who hear me to form an opinion as to whether the theory I have propounded is or not likely to prove a satisfactory explanation of some of the more striking of cometary phenomena. The theory is one which, as I take it, explains more and assumes less than is common with such theories. Besides those I have already named, there are other points which I conceive it fully to account for, but upon which it is quite impossible for me to touch in the brief space to which I feel I ought to confine my present remarks. There are points upon which I am of opinion that the application of quantities is practicable, and the theory itself I not only believe to be true, but the truth of it I conceive to be capable of numerical verification. To these and many other matters I hope to invite your attention on some other occasion, if you consider my present treatment of the subject as justifying any further expenditure of your time.

GLASGOW PHILOSOPHICAL SOCIETY.
(Chemical Section).

Monday, April 29th, 1872.

Alexander Whitelaw, Esq., in the Chair.

Dr. T. E. Thorpe made several short verbal communications, two of which were on subjects brought under the notice of the Chemical Society on the 18th of April, and duly noticed in the report in the Chemical News. The first of the others was on "*A Trisodium Phosphate obtained in the Manufacture of Soda.*" The substance spoken of was peculiar in the fact that it contained vanadate and fluoride of sodium. Rammelsberg had analysed a similar substance, and had assigned to it the formula $NaPO_4+10H_2O$, but he (Dr. Thorpe) had arrived at the following formula:—$2NO_3PO_4+NaF+19H_2O$. The vanadium was very small in amount. Dr. Thorpe also briefly referred to a mineral from Sicily, the composition of which was—

Silica	52·71
Triferric tetroxide ..	19·44
Lime	6·61
Magnesia	1·85
Alumina	19·09
	99·70

Papers were afterwards read on "*The Action of Dilute Saline Solutions on Lead*," and on "*A Double Sulphide of Gold and Silver*, by Mr. M. M. Pattison Muir, F.C.S.; on "*The Zircons of Ceylon*," by Mr. M. H. Cochran, F.C.S.; on "*Iona Pebbles*," and on "*The Action of Various Charcoals on Nitrogenous Organic Matter*," by Mr. E. C. C. Stanford; on "*The Part which Iron and Alumina Oxides play in the Manufacture of Super-Phosphate*," and on "*The Comparative Value of Mineral Phosphates*," by Mr. T. L. Patterson, F.C.S.; and on "*The Separation of Phosphoric Acid, Oxide of Iron, Alumina, Lime, and Magnesia*," by Mr. Thomas R. Ogilvie. Most of these papers will appear in our pages.

Owing to the great plethora of papers at this, the closing meeting of the session, there was no time left for discussion; and great regret was expressed that such valuable and suggestive communications should be passed in silence.

CORRESPONDENCE.

SODIUM AND ACETIC ETHER.

To the Editor of the Chemical News.

Mr. Otto Richter's paper, which is being published in the Chemical News, seems to call for a few remarks. He appears to consider that his "Typo-nucleus Theory" derives support from the fact of its accounting for the modifications which pressure occasions in the products of the action of sodium on acetic ether. He appears to imagine that when sodium and acetic ether are brought together at ordinary atmospheric pressure, they yield hydrogen, and when they are brought together at high pressures, they yield little or no hydrogen.

Unfortunately, however, for the "typo-nucleus theory," there is no experimental ground for maintaining "that there exists an intimate relation between the degree of gaseous pressure which is brought to bear upon the mixture of sodium and acetic ether, and the quantity of hydrogen which is evolved during the reaction."

The origin of this erroneous statement is, I believe, to be traced to a hasty suggestion to be met with in Dr. Frankland's paper in the *Proceedings of the Royal Society*. Dr. Frankland was betrayed into the assertion that the experiments in which hydrogen had been obtained differed from the experiments in which hydrogen had not been obtained by being performed under considerable pressure. Dr. Frankland had, by an oversight, confounded working in a sealed tube with working under pressure. It is hardly necessary for me to point out that working in a sealed tube does not necessarily imply working at higher than atmospheric pressures; indeed, if the tube be boiled out or otherwise exhausted before being hermetically sealed, the working may even be at reduced pressures. In some of the experiments sodium dissolved in acetic ether without sensible evolution of hydrogen at pressures hardly if at all exceeding that of the atmosphere. The physical difference between the experiments was merely a difference in the shape of the vessel employed to contain the materials. Apparently Dr. Frankland employed a vessel somewhat globular in shape, and I employed a vessel of a cylindrical shape.—I am, &c.,

J. Alfred Wanklyn.

London, May 6, 1872.

ORIGINAL RESEARCH.

To the Editor of the Chemical News.

Sir,—May I be permitted to make a few remarks on the subject which has been handled by "A. T." and "Graduate." I may say that I quite agree with "A. T." when he asks for "recognition," and I agree further with him in thinking that the recognition should be accorded by an existing power, such, for instance, as the Chemical Society. Such a course might be the means of encouraging much good work. Before giving my own views, I would point out what I consider to be a fatal mistake in the suggestions of "Graduate." He asks for more than "recognition" in suggesting that "a system of national, or even international, prizes and rewards for scientific research be instituted." I am sure "Graduate" will forgive my fervour when I say that it appears to me marvellously like making paupers of scientific men to ask that they should receive a bit of sugar-stick for each of their efforts; and to descend to the practicability of the proposed scheme, may I ask "Graduate" who would be entrusted with the distribution of the "prizes and rewards."

The incentive which could be legitimately offered to a scientific man should, I think, be nothing more than the *recognition* of his efforts, and such recognition could be accorded by a society, such as the Chemical Society, in the shape of an honorary title. Such an incentive would reach all classes of science-workers, from the humblest assistant in the laboratory of a chemical works even up to our Metropolitan Professors.—I am, &c.,

Sidney W. Rich.

MISCELLANEOUS.

The Royal Society.—The following gentlemen are recommended by the Council for election into the Royal Society on June 6th:—Professor William Grylls Adams, M.A.; Andrew Leith Adams, M.B.; Frederick Le Gros Clark, F.R.C.S.; Professor John Cleland, M.D.; Prof. Michael Foster, M.D.; Prof. Wilson Fox, M.D.; Arthur Gamgee, M.D.; Rev. Thomas Hincks, B.A.; Prof. William Stanley Jevons, M.A.; Prof. George Johnson, M.D.; Prof. Thomas Rupert Jones; Major Thomas George Montgomerie, R.E.; Edward Latham Ormerod, M.D.; Edward John Routh, M.A.; William James Russell, Ph.D.

Broderip Scholarships.—Two Scholarships of the annual value of £30 and £20 respectively, tenable for two years, have been founded by the Governors of the Middlesex Hospital, for the encouragement of the study of Medicine and Surgery, in memory of the late Francis Broderip, Esq., a munificent benefactor to the Hospital. These scholarships will be open to competition, at the end of each winter session, amongst the general students of the Hospital who shall have completed their third year of study at the Medical College. The successful candidates will be required to attend and work at the Hospital for a fourth year, during which period they will be eligible for the various resident appointments.

Highton's Galvanoscope.—The galvanoscope which Mr. Highton exhibited at the Society of Arts, and by which he showed that simply looking at a thermopile was sufficient to signal across the Atlantic, was constructed in the following manner:—A strip of gold leaf, the thinnest which could be procured, was hung vertically between two wires, one at the top and the other at the bottom, and metallically connected with both. There were means by a telescopic movement of adjusting the tension of the gold leaf. The whole was inserted in a small glass chamber with flat walls and placed in a powerful magnetic field. The slightest current sent through the gold-leaf deflects it in a direction regulated by its position with regard to the poles of the magnet. A strong beam of light was then sent across the gold leaf in a direction at right angles to its plane of motion, and by a condensing lens a magnified image of the leaf was thrown upon a screen. The motions of a gold leaf fixed in this manner reveal in a most wonderful manner the slightest variation of an almost infinitesimal current. We hear arrangements are being made for coupling up all the lines to Bombay, and working through in one unbroken circuit by means of one of these galvanoscopes.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 15, 1872.

In addition to a large number of papers and memoirs relating to mathematical, astronomical, meteorological, and natural history subjects, this number contains the following papers more particularly bearing upon chemistry:—

Researches on Crystalline Dissociation.—P. A. Favre and C. A. Valson.—The first portion of a monograph treating on the thermical relation of the phenomena of crystallisation and solution. Notwithstanding the very high scientific value of this memoir, elucidated by several tabulated forms exhibiting results of experiments, the contents are not well suited for any useful abstraction.

Industrial Cultivation of Hops.—A. Muntz.—The author has instituted, with great care and on a practically large scale, a series of experiments, with the view of ascertaining the quantity of materials consumed by the hop-plant during its growth and development from spring to autumn (hop-picking time), for a number of 6316 plants placed on a hectare (=2·47 acres). The quantities alluded to, expressed in kilos., are—Water, 11270·270 kilos.; carbon, 2624·361; hydrogen, 315·547; oxygen, 2011·393; nitrogen, 91·141; phosphoric acid, 22·699; magnesia, 24·352; potassa, 41·812; soda, 0·455; non-specifically determined mineral matters, 133·278.

Heat of Formation of the Oxygen Combinations of Nitrogen.—Dr. Berthelot.—A thermo-chemical essay of considerable value, but not suited for abstraction.

Reclamation of Priority on the Subject-matter of a Memoir of M. Grüner relating to the Action of Oxide of Carbon upon Iron and its Oxides.—A. Gillot.—The author states that more than four years ago he presented to the Académie a memoir which has never been reported upon, and in which, as proved by a long quotation here reproduced, he made, earlier than M. Grüner, discoveries which the last-named author claims as his own.

Spectrum of Aqueous Vapour.—Lecoq de Boisbaudran.—Illustrated by an engraving.

New Facts relating to the History of Phenols.—L. Dusart and Ch. Bardy.—The authors relate, in the first part of this memoir, the results of a series of investigations made with the view to ascertain whether, by the etherification of phenol, it is possible to reproduce the original body by an inverted reaction. This is found to be the case, so that chloride of phenyl is again converted into phenol; chlorated toluen yields hydrate of cresyl; bromide of naphthyl yields naphthol. In the second portion of this paper the authors state that they have repeated their former experiments, whereby a mixture of chlorhydrate of ammonia, hydrochloric acid, and phenol, heated to 250°, yields diphenylamine, a fact which Girard and De Laire contradicted after having made the same experiment. The result obtained by the first experimenters is the same.

Discovery of a Prehistoric Human Skeleton of the Reindeer Age, at Langerie-Basse (Dordogne, France).—E. Massenat, P. Lalande, and Cartailhac.

La Revue Scientifique de la France et de l'Etranger, April 20, 1872.

This number does not contain any original papers on chemistry, but we call attention to a memoir:—

Transit of Venus over the Sun in 1874.—C. Wolf.—Illustrated with woodcuts.

Bibliography.—Under this heading we call attention to the following recently-published works:—"Le Lendemain de la Mort, ou la Vie future Selon la Science," par Louis Figuier; Paris, Hachette. "Leçons de Chimie Agricole, études sur l'Atmosphere, le Sol, et les Engrais," par A. Bobierre, Directeur et Professeur de Chimie de l'Ecole Supérieure des Sciences et des Lettres de Nantes; 1 vol. in 8vo, with geological map of France and numerous woodcuts; Paris, G. Masson. Both these works are here highly eulogised; the first-named is the fourth and improved edition.

Annalen der Chemie und Pharmacie, April, 1872.

This number contains the following original essays and papers:—

Conversion of the Normal Butyl-Alcohol into Butylen-Hydrate or Ethyl-Methyl-Carbinol.—E. Linnemann.—This is the 15th portion of a monograph treating on the preparation of the fatty alcohols from their initial constituents; the 16th portion of this work treats on the conversion of normal butyl-alcohol into isobutyl-alcohol or fermentation butyl-alcohol; the 17th part treats on the reduction of isobutyric acid into isobutyl-alcohol; part 18 treats on the conversion of isobutyl-alcohol into trimethyl-carbinol; part 19 treats on reversion formations (*Rückbildungen*) in the tetryl series, part 20 (the last) treats on the reversion formation of isobutyl-alcohol from trimethyl-carbinol.

Boiling-point Differences.—E. Linnemann.—This excellent memoir is elucidated by a series of tabulated forms exhibiting the boiling-points of a series of organic substances. The following conclusions can be drawn from the author's researches:—(1.) For an equal difference of composition there is *not* an equal difference of boiling-point. (2). The difference of boiling-point decreases, in the greater number of the hitherto-investigated series, with increase of quantity of carbon—at least this holds good for the initial member (*Anfangsgliedern*). (3.) In many of the series the difference of boiling-point is almost the same, but in others it increases with increase of quantity of carbon. (4.) The isomeric intermediate (*intermediären*) ethers of the fatty alcohols and fatty acids have *no* equal boiling-point.

Action of Chromic Acid upon Oxide of Carbon, Hydrogen, Marsh Gas, and Ethylen.—E. Ludwig.—The author describes at length, and illustrates with a woodcut, his method of manipulating with the gases just named, for the purpose of testing the action of saturated solutions of chromic acid upon them. It appears that carbonic oxide is rather readily oxidised by chromic acid forming carbonic acid; hydrogen, although far more slowly, is also oxidised, water being the result; marsh gas is not at all acted upon, even when left in contact with chromic acid for a week; ethylen is not—at the ordinary temperature at least—very readily acted upon, and, in addition to water and carbonic acid, there is also formed formic acid, and probably acetic acid.

Gas Analysis.—E. Ludwig.—This essay, elucidated by a series of tabulated forms exhibiting results of experiments, treats at length on improved methods for absorbing from gaseous mixtures the following gases:—Sulphuretted hydrogen, sulphurous acid, and carbonic oxide.

Influence of a Change of the Specific Gravity on the Melting-point.—F. Mohr.—The contents of this memoir, notwithstanding its high scientific value, are not well suited for useful abstraction.

How does Salicylic Acid become formed from Brombenzoic Acid fusing at 155°?—H. Hübner.—After first referring to the researches published on this subject by Barth, Remsen, Friedburg, and others, and pointing out the discrepant results of experiments, the author records the results of a series of experiments made with perfectly pure materials, whereby it is proved that perfectly pure brombenzoic acid (fusion-point 155°) does not yield, when fused with caustic potassa, any salicylic acid at all; but the author admits that, as in many other instances, salicylic acid may be formed, as, for instance, when pure phenol is heated to from 193° to 280° for several hours with caustic potassa; so that salicylic acid occurs as a collateral product of reaction.

On some of the Condensation Products of Aldehyde.—Dr. A. Kekulé.—The first instalment of a very exhaustive and lengthy monograph on this subject. Notwithstanding the high scientific value of this paper, it does not admit of useful abstraction,—an observation equally applying to the two following memoirs.

So-called Chloraceten and Polymeric Modifications of Aldehyde.—A. Kekulé and Th. Zincke.

Oxidation of Ketones a means of Determination of the Constitution of the Fatty Acids and Alcohols.—A. Popoff.

Contribution to the History of the Discovery of Chloroform.—Dr. J. Von Liebig.—The eminent *savant* calls attention in this paper to the facts elucidated by several instances, that, owing to political causes, the publishing of French scientific periodicals has been often very much retarded,—so much so that, for instance, the *Annales de Chimie et de Physique* for September and October (double number), 1871, were not published until the middle of February last. Something similar happening in 1831 occasioned Soubeiran's memoir on chloroform (then termed *éther bichlorique*) to appear (1831) after the author's researches on the action of chlorine upon alcohol (a preliminary notice of which was published in Poggendorff's *Annalen* for November, 1831) had been published, and chloroform had been discovered by him. This is also verified by Dumas, who was informed of this discovery six weeks before Soubeiran's memoir was published.

Amides and Anilides of Succinic Acid, their Properties, and Relation to each other.—M. Menschutkin.—This very lengthy memoir is divided into the following sections:—Introduction; metallic derivatives of succinimide into succinamide; transition (*Uebergang*) of imides and amides into amin-acids; transition of succinamide into succinaminic acid; transition of imides into amides; formation of succinimide into succinanil.

Note on Succinalide.—M. Menschutkin.—Pure succinalide, $C_{16}H_{16}N_2O_2$, is insoluble in water, soluble in boiling alcohol and crystallising from this fluid; fusion-point 226·5° to 227°. This body is a very stable compound, completely resisting the action of many strong reagents.

American Journal of Pharmacy, April, 1872.

In addition to several original papers more strictly relating to pharmacy, pharmacognosy, and pharmaceutical technology, this number contains the following original papers and memoirs relating to chemistry:—

Fruit of Magnolia Tripetala.—W. Procter.—The author records at great length the results of his valuable researches on the chemical constituents of the fruit of the tree popularly known in the United States as umbrella-tree, owing to the size of its leaves and flowers. The *Magnolia* tribe is very numerously represented by various species in the States, and among it some most beautiful trees are extant. The main results of the author's investigation show that the fruit of the *Magnolia tripetala* contains a crystalline (resinoid) principle analagous to liriodendrine [the bitter principle of the bark of the tulip poplar, *Liriodendron tulipifera*, also a native of the United States, but introduced into Europe, where it is met with chiefly as ornamental in plantations and parks]; further, a solid resin precipitable by subacetate of lead, a soft pungent resin, fixed oil, volatile oil, gum, glucose; but no investigation was made for acid or colouring matter.

A New Source of Potash Supply.—H. Hazard.—In this memoir the author sets forth the results of his researches of the cobs of Indian corn (*Zea mais*), very largely grown in the United States, and by a series of analyses the fact is brought out that the cobs contain on an average, in 1000 parts, 7·62 parts of carbonate of potassa, or nearly twice as much as the best specimens of wood. The author further exhibits statistical data which prove that, taking the average production of corn in the States alone, there might be extracted from the ash of the cobs (a great portion of which are used as fuel for steam-boilers) a quantity of no less than 51,612 tons of pure carbonate of potassa, while, moreover, a larger quantity of chloride of potassium may be simultaneously obtained: 100 parts of the cobs, dried at 100°, contain on an average 1·171 ash, consisting of 0·899 KCl, 0·836 K_2CO_3, 0·230 silica, lime, iron, and charcoal, and 0·105 loss.

To Detect Sulphuric Acid in Vinegar.—J. T. King.—The following process will detect the 500th part of free sulphuric acid, and is accurate for all practical purposes. An ounce of the vinegar to be examined is, by evaporation upon a water-bath, reduced to about half a drachm, or the consistency of a thin extract; when quite cold, half a fluid ounce of strong alcohol (not methylated spirit) is added, and thoroughly incorporated; the free sulphuric acid will be taken up by the alcohol, to the exclusion of any sulphates; the alcoholic liquid solution should stand for several hours, and then be filtered; add to the filtrate 1 fluid ounce of pure distilled water, and evaporate the alcohol off next by the application of a gentle heat; the remaining liquid is again left standing for several hours, and again filtered; to the filtrate, previously acidulated with a few drops of pure hydrochloric acid, a solution of chloride of barium is added, which, if sulphuric acid be present, will yield a white precipitate.

On Precautions in Dispensing Poisons.—W. C. Bakes.—The contents deserve the serious notice of pharmacists, who may also learn, perhaps with surprise, that oil of peppermint is occasionally adulterated (at least in the United States and Canada) with castor oil and alcohol, the two latter ingredients having been found present, in a sample tested by E. B. Shuttleworth, to the extent of 38·18 and 29·10 per cent respectively.

Les Mondes, April 18, 1872.

Medical Faculty at Bordeaux.—The Municipal Council of the city alluded to, having requested that there might be established a medical faculty there, have offered—(1) to grant, for at least 12 consecutive years, the necessary buildings, and the keeping of the same in good repair; (2) to furnish the buildings and library with all requisites; (3) to pay yearly all the expenses which may be incurred in excess of those which the State usually pays, and this in addition to an annual grant of £6000, and also in addition to a grant of £132,000 towards the expenses of first establishment. There are now in France only two medical faculties, viz., at Paris and Montpellier; the third was formerly at Strasburg.

Ingeniously-contrived Method for Working under Ground as well as under Water.—F. Durand.—Although strictly an engineering subject, we call attention to this paper, illustrated by engravings and a full text description.

Action of Light upon the Solution of Iodine in Bisulphide of Carbon, and Description of a Newly-contrived Photometer giving Continuous Indications.—Rev. Father F. S. Provenzali, S.J.—The author states that he uses, in his lectures on experimental physics, thermometers filled with a concentrated solution of iodine in sulphide of carbon, because, in consequence of the great coefficient of dilatation, that liquid is very useful to exhibit to students even small variations of temperature. By accident it was found that when such a thermometer is brought from a dark place into the sunshine—even when a very sensitive mercurial thermometer, removed under the same conditions, does not indicate any change of temperature—the thermometer, filled with a concentrated solution of iodine in sulphide of carbon, exhibits a rise. The author, having further investigated this phenomenon, has constructed a photometrical apparatus consisting of two thermometers,—one a mercurial, the other filled with the solution alluded to: these two thermometers exhibit the same indications when placed in darkness, but when placed in daylight the indications of the sulphide of carbon and iodine thermometer exceeds the indications of the mercurial one, the more so as the light is more intense.

Intensity of the Solar Light and that Emanating from other Sources.—Rev. Father F. S. Provenzali, S.J.

MEETINGS FOR THE WEEK.

Monday, May 13th.—Royal Geographical, 8.30.
—— London Institution, 4. Prof. Bentley, F.L.S., "On Elementary Botany."
Tuesday, 14th.—Civil Engineers, 8.
—— Royal Institution, 3. E. B. Tylor, F.R.S., "On the Development of Belief and Custom amongst the Lower Races of Mankind."
—— Photographic, 8.
Wednesday, 15th.—Society of Arts, 8.
—— Pharmaceutical, 11 (Annual Meeting).
—— London Institution, 7 (Conversazione).
Thursday, 16th.—Zoological, 4.
Royal Institution, 3. Dr. Tyndall, LL.D., F.R.S., "On Heat and Light."
—— Royal, 8.30.
—— Royal Society Club, 6.
—— Chemical, 8. "Notes from the Andersonian University." David Page and A. D. Keightley, "On the Determination of the Solubilities and Specific Gravities of certain Salts of Sodium and Potassium." Mr. Brown, "On the Influence of Pressure on Fermentation," Part I. C. Greville Williams, "On Chinoline and Leucoline." J. Alfred Wanklyn, "New Tests for some Organic Fluids." C. O. Sullivan, "On the Products of the Transformation of Starch." R. W. Atkinson, "An Examination of the Recent Attack upon the Atomic Theory."
Friday, 17th.—Royal Institution, 9. Prof. Abel, F.R.S., "On the More Important Substitutes for Gunpowder."
Saturday, 18th.—Royal Institution, 3. Prof. Roscoe, F.R.S., "On the Chemical Action of Light."

NOTES AND QUERIES.

Extracting Copper Ores.—Can any of your readers inform me whose process is considered the best (practically) for extracting copper ores by the wet process,—that is to say, by precipitation,—and how I can obtain a copy of the same?—F. Cant.

Poisoning by Strychnia.—In the stomach of a dog poisoned by strychnia, it can be detected; but if death has been caused by powdered nux vomica, how can that be proved? as by the methods used for the detection of the alkaloid the powder would still retain its active principle.—G. C.

University of Freiberg.—Can your readers give me information about the University of Freiberg, in Saxony, as a place of instruction in geology, mineralogy, and chemistry? I should also be glad to know which of the German Universities are held to be the best for learning these three subjects, and when their terms end. Any information on these points will oblige.—Undergraduate.

Arresting Fermentation.—In a letter from Dr. Baker to Surgeon Wells, of the U. S. Navy, published in the *Journal of Materia Medica*, he says, "Catalysis may be illustrated, in a comprehensive manner, by what occurs in distilleries, where it is desirable to arrest fermentation in the 'fermenting tuns' before it reaches the lactic and acetic stages. If a few drops of tallow, from a candle in a melted state, be dropped into fermenting 'wort,' the fermentation immediately ceases, notwithstanding many thousand gallons are acted upon." I should be glad if any of your correspondents will tell me if this is generally known, and if so, what is the explanation.—Carbolic.

Grey and Brown Acetate of Lime.—(Reply to S. S.)—The value of the commercial acetates always depends upon the acetic acid therein contained, and the quantity thereof can be ascertained by the following methods:—From a weighed quantity of the acetate to be tested the acetic acid is driven off, by acting upon it with sulphuric acid, in a deep-bellied retort, to which heat is applied, the acetic acid distilled over being condensed in a well-cooled receiver; about the end of the operation a current of steam is passed through the retort, to drive off the last traces of the acetic acid, the quantity of which is ascertained by means of a standard solution of caustic soda. The other method consists in converting the acetate under examination into acetate of soda, and next converting that salt, by ignition, into carbonate of soda, the quantity of which can be ascertained alkalimetrically. As regards acetate of lime, there are three solid varieties of it met with in commerce, viz., the white, grey, and black (or brown) acetate: these contain, of course, variable quantities of pure acetate of lime, which may be present in quantity from 69 to 83 or 85 per cent.

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THE CHEMICAL NEWS.

Vol. XXV. No. 651.

THE MOLYBDATE PROCESS: ESTIMATION OF PHOSPHORIC ACID.

By JOHN PARRY.

I trust the following observations, the result of two years' constant practice in the determination of Ph contained in ores, steel, and pig-iron, may be found useful to some of your readers; and if, in giving the method as practised in the laboratory I may be accused of entering into unnecessary details, I must plead in excuse that only by *exactly* working as herein described have I been able to attain both speedy and trustworthy results. I have ceased to use the ordinary nitric acid solution of molybdenum, and in lieu thereof use an aqueous solution of molybdate ammonia, 50 grms. in 1 litre of H_2O.

I had at first great difficulty in getting the whole of the Ph, and in some instances failed to get a precipitate from iron solution known to contain Ph. It was, however, soon observed that precipitation was retarded in a strongly acid solution, and that Ph could not be thrown down from neutral solutions.

It now occurred to me that it would be well to first add a slight excess of NH_3, and carefully acidify with HCl or N_2O_5 indifferently (the latter, however, proved to be the best); and ultimately the HCl solution of ore or iron containing Ph, and about ¼ litre bulk, was treated as follows:—

(1). NH_3 added until complete precipitation of Fe_2O_3.

(2). N_2O_5 carefully added in sufficient quantity only to just re-dissolve the precipitated Fe_2O_3.

(3). Heated to boiling; 30 c.c. of molybdate solution added; solution well agitated (glass flasks are most convenient for this); if the usual yellow crystalline precipitate does not appear, solution is again boiled, four or five drops of N_2O_5 added, the flask well shaken from time to time, and more acid added drop by drop until a distinct precipitate appears. The boiling must now be discontinued, or a bulky light yellow precipitate falls down, but the solution must be kept as hot as possible and well agitated from time to time.

Provided the above details are strictly observed, the greater part of the Ph is precipitated almost instantaneously. I have often had the whole down in two hours, failing, on further trial, to get even traces from the filtered solution. Too much care cannot be taken in acidifying with N_2O_5, and some practice is required ere the exact point can be judged.

Chemical Laboratory,
Ebbw Vale Iron Works.

PRELIMINARY NOTICE OF SOME PRODUCTS FROM NATAL ALOES.

By WILLIAM A. TILDEN, D.Sc. Lond.

Nataloïn.

The aloïn of Socotrine aloes appears to be identical with that obtained from Barbadoes aloes, as they crystallise in the same manner, give the same colour reactions with oxidising agents, and both furnish chrysammic acid by treatment with nitric acid. Natal aloes is a variety which contains a crystalline body of entirely different properties. This was examined for the first time by Flückiger,[*] and called by him nataloïn. It is readily distinguished from barbaloïn by its comparatively slight solubility either in water or in alcohol, by its crystalline form, and by furnishing, when acted upon by nitric acid, no chrysammic acid, but, as I have found,[*] picric in addition to oxalic acid. It contains no water of crystallisation. Crystallised from spirit, and dried at 100° C., it gave me the following results:—

1.—0·5066 grm. burnt with a mixture of lead chromate and potassic dichromate gave 1·1070 CO_2 and 0·2775 H_2O.

2.—0·3715 grm. gave 0·8110 CO_2 and 0·1965 H_2O.

The percentages of carbon and hydrogen calculated from these data agree very nearly with the formula $C_{25}H_{28}O_{11}$.

		Theory.	I.	II.
C_{25}	300	59·52	59·59	59·53
H_{28}	28	5·55	6·07	5·86
O_{11}	176	34·92	—	—

They also approximate very closely to the average of the determinations made by Professor Flückiger, though the individual numbers quoted by him diverge very considerably from the mean.

Flückiger's Analyses of Nataloïn.

						Mean.
C	58·99	59·14	61·18	58·38	60·15	59·56
H	6·17	6·24	5·92	5·95	6·24	6·10

Acetyl-nataloïn.

Hitherto, although numerous experiments have been tried, I have found it impossible to obtain a chloro-, bromo-, or nitro-derivative of nataloïn.

When placed in contact with acetyl-chloride, a reaction commences almost immediately, and is complete after warming for a short time. The varnish-like residue left after chasing off the excess of the chloride and hydrochloric acid, was dissolved in a mixture of alcohol and ether. In a short time, well-defined but microscopic crystals consisting of rhombic plates and octahedra were deposited. 0·143 grm. gave 0·307 CO_2 and 0·070 H_2O.

The percentages of carbon and hydrogen agree with the formula $C_{37}H_{40}O_{17}$.

		Theory.	Experiment.
C_{37}	444	58·73	58·54
H_{40}	40	5·29	5·38
O_{17}	272		

This formula is that of nataloïn in which 6H have been replaced by $6C_2H_3O$—

$$C_{25}H_{22}(C_2H_3O)_6O_{11}.$$

Action of Caustic Potash.

The products of the oxidation of socotrine aloes by means of caustic potash were studied some years ago by Hlasiwetz.[†] By melting this variety of aloes with caustic potash and a small quantity of water, dissolving the mass in water, acidifying with sulphuric acid, and agitating the whole with ether, an ethereal solution was obtained, in which two crystalline bodies were discovered. These were the para-oxybenzoic acid, $C_7H_6O_3$, of Fischer and Saytzeff, and α orcin, $C_7H_8O_2$.

Some Natal aloes was fused with potassic hydrate according to this method; the ethereal solution obtained left an aqueous liquid, and by continuing the distillation a small quantity of acetic acid passed over. On allowing the liquid to cool, a crop of well-formed colourless crystals was deposited; these, separated from the mother-liquor, were re-crystallised. They are only slightly soluble in cold water, and the solution possesses a strongly acid reaction. They melt at about 205° (the point was not accurately determined), crystallising on cooling, and, when more strongly heated, volatilise with partial decomposition. Placed over oil of vitriol, they effloresced.

0·151 grm., dried at 100°, gave 0·3365 CO_2 and 0·065 H_2O. These data give percentages which agree with those required by the formula of para-oxybenzoic acid.

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[*] *Proc. Brit. Pharm. Conf.*, 1871.

[*] *Pharm. Journ.*, New Series, vol. ii., p. 441.

[†] *Ann. d. Chem. u. Pharm.*, cxxxiv., 287.

		Theory.	Experiment.
C_7	84	60·86	60·77
H_6	6	4·34	4·63
O_3	48	34·78	—

The mother-liquor from which these crystals were obtained was brown and syrupy; it was diluted, precipitated by acetate of lead, the excess of lead removed by exact precipitation by sulphuric acid, and the filtered liquid evaporated, first by the aid of heat, then *in vacuo*. A coloured syrupy residue was thus obtained, which gradually set into a crystalline mass. It was too small in quantity to attempt to purify further, but its reactions were carefully compared with those of the three known orcins.

For small quantities of β orcin and resorcin with which these experiments were made I am indebted to the kindness of Dr. Stenhouse.

A weak aqueous solution of each was employed.

(1). Orcin and resorcin with ammonia redden very slowly. β orcin and the new compound turn purplish red in a few minutes.

(2). With potash resorcin gives a green colouration; orcin becomes slowly reddish brown; β orcin and the new compound become rapidly purple, afterwards brown.

(3). A slip of deal, wetted with the solution, and then with hydrochloric acid, and dried, becomes, in the case of resorcin, blue; with the others a rich purple colour is produced.

(4). Aqueous chlorinated soda gives, with resorcin and orcin, a violet colouration which almost immediately changes to a dull green. With β orcin and the compound from Natal aloes an intense crimson colouration is developed, which is much more permanent than the violet produced by orcin.

(5.) A portion of the syrupy solution, treated with concentrated hydrochloric acid and potassic chlorate, gave, in twelve hours, a crystalline chloro-derivative. There was not sufficient for analysis.

These experiments convince me that the orcin from Natal aloes is not α orcin; it is probably β orcin, or it may be the next higher homologue.

I very much regret that the small quantity of material operated upon did not yield sufficient of the substance to complete its purification. I hope, however, to confirm my opinion by further experiments and an analysis of the body.

The production of β orcin from a new and available source would possess considerable interest, as at present, in consequence of the uncertainty attending its preparation from usnic acid, from which alone it has hitherto been procured, its chemical history has been only imperfectly traced out.

THE LOGWOOD TEST FOR ALUM IN BREAD.

By JOHN HORSLEY, F.C.S.

Mr. Davis having, at the conclusion of his paper (Chemical News, vol. xxv., p. 207), invited chemists to give their experience on this subject, I yield to his request, inasmuch as, from having used logwood for several years past, I am in a position to speak of its being *perfectly reliable* if used precisely in the manner I am about to describe. I have on former occasions contributed papers to the Chemical News relative to the detection of alum in bread by the incineration process, but as such analyses occupy a much longer time than is required by law to give notice of proceeding against a baker for adulteration, I was necessitated to search for a short, and at the same time reliable, one. Knowing well that Mr. Hadow's system of using a decoction of logwood was *per se* of little or no value, as iron, copper, and other things produced a similar reaction, it occurred to me to use a tincture of logwood together with a saturated solution of carbonate of ammonia; and after making a variety of experiments with loaves purposely adulterated with different materials, I found that iron was the only substance that clashed with alum in its results, but that even these, when mixed, could easily be distinguished by proper procedure.

Feeling so thoroughly satisfied with this compound test, I placed it in the hands of the police, and with their assistance I surveyed the whole of the county of Gloucester twice, visiting the different bakers' and millers' establishments, and have therefore had some thousands of loaves pass through my hands, and succeeded in obtaining upwards of 200 convictions which it would have been impossible to have done by the incineration process, forty-eight hours being the time allowed to take proceedings in. The last case I had was that of a Herefordshire miller, in 1870. I not only tested the flour and bread made with it in the presence of the magistrates, but actually extracted the alumina by percolation and tested the filtered liquor afterwards, when in each case a deep purple or violet-blue colour was the result. The miller confessed that the flour contained alum, which his men had put in by mistake; and he was accordingly fined fifteen guineas.

At Dr. Carter Moffat's request, I sent him a sample of this alumised flour, and was surprised afterwards to find him stating in his lecture at Glasgow that alum and logwood gave a *dark red*; hence my letter in the Chemical News of September 15, 1871 (vol. xxiv., p. 131), which Mr. Davis now alludes to. I therefore distinctly state that bread containing alum will, in every case, on being treated with logwood in solution, ultimately go blue, it being merely a question of time, although it may take a straw-coloured tinge at first; in conjunction, however, with carbonate of ammonia, the blue colour is more rapidly promoted, which is the beauty of that combination.

As my process was explained and published in the newspapers at the time, perhaps Mr. Davis and others may not have seen it, I therefore now describe it in full.

(1). Make a tincture of logwood by digesting for eight hours 2 drams of freshly-cut logwood chips in 5 ozs. of methylated spirit in a wide-mouthed phial, and filter.

(2). Make a saturated solution of carbonate of ammonia in distilled water.

A teaspoonful of each solution mixed with a wine-glassful of water in a white-ware dish forms a pink-coloured liquid. Bread containing alum, immersed in it for five minutes or so, and stood upon a plate to drain, will in an hour or two go blue on drying; but, if no alum is present, the pink colour fades away. If, on drying, a greenish tinge appears, that is an indication of copper, as carbonate of ammonia produces that colour, but never a blue.

As a counter-check for iron, a piece of the moist blue-coloured bread may be drenched with a few drops of glacial acetic acid, when that containing iron is bleached of a dirty white colour, but with alum a rose-pink or slight buff colour will be observed.

Or it may be tried another way, thus:—Take a piece of the bread in its plain state, and having digested it in dilute acetic acid for an hour or so, press out the liquor and filter; then put in a lump of carbonate of ammonia, and, when all effervescence ceases, add to the clear liquor a few drops of solution of sulphide of potassium or sodium. If iron is present it will be indicated by a dark colour, there being no colour produced with alum; but the addition of a little tincture of logwood immediately reveals it.

I might even go further, and say that if necessary you may quantitatively estimate the alumina thus:—Take, say, ¼ lb. of crumb bread, digest it in a clean basin with some dilute acetic acid, and allow it to stand a few hours; then break up the mass and pass the liquor through a glass percolator, the rim being covered with calico, repeating the percolation two or three times till the liquor is clear. Throw in a lump of carbonate of ammonia to saturation, and add tincture of logwood in excess, when, if alum is present, a dark blue colour will be produced, with a flocculent blue precipitate on standing awhile. Collect this precipitate on a filter, wash it off into a dish with dilute nitric acid, and evaporate the red liquor to dryness. Collect the residue in a small Berlin crucible and ignite it at a red heat, when a white powder will be obtained consisting of alumina, with possibly a little lime; treat this with liquor potassæ, to dissolve out the alumina, mix with a little water, filter, and boil with carbonate of ammonia to obtain the pure alumina.

Having now thoroughly exhausted the subject, I trust the perusal of this paper will meet the approval of my readers, and that we shall hear no more of the so-called uncertainty of the logwood test, which I am persuaded is far more reliable than is generally believed; for it seems discreditable to chemistry that there should be such a variety of opinions as to shades of colour, &c.

I entirely agree with Mr. Davis, that potatoes in bread never yield so blue a colour as to be mistaken for that of alum and logwood.

The Laboratory, Cheltenham,
May 6, 1872.

ON THE PRESENCE OF IODATE OF CALCIUM IN SEA-WATER.

By E. SONSTADT.

(Continued from page 196).

In the preliminary note, of which this is a continuation, I stated that the white precipitate formed in sea-water by the addition of a minute proportion of ferrous sulphate was ferrous iodate, but did not give further confirmation of the fact than was derived from the evidence adduced to prove the presence in sea-water of an oxidised compound of iodine, and the similarity between the precipitate produced by ferrous sulphate in sea-water to that produced by the same reagent in a very dilute solution of iodate of calcium. If a very small crystal of ferrous sulphate is dropped into a test-tube containing at least 50 c.c. of sea-water, and the liquid poured off the brown precipitate after a few hours, the addition of a drop or two of hydrochloric acid to the precipitate will cause separation of a trace of iodine, which may be recognised by addition of a drop of carbonic disulphide. When a small crystal of ferrous sulphate is dropped into a beaker containing sea-water, a trail of white clouds of the ferrous iodate shows the path of the crystal, which, however, as it lies on the bottom of the beaker, remains surrounded by clear liquid; but at a distance beyond rings of the iodate form, showing the solubility of the precipitate in excess of the precipitant. After a while, whether the ferrous salt is used in excess or not, a brown, basic, ferric salt separates in flakes, which still retains iodine; and, at least, so far as when one part of ferrous sulphate is taken to ten thousand of the water, and two hours allowed for the reaction, the filtered liquid still retains in solution a trace of undecomposed iodate. Out of the proportions of ferrous sulphate to sea-water tried, three parts to the million were found, under like circumstances, to give the most iodine in the precipitate; but it does not therefore follow that that proportion is a reliable indication of the proportion of iodic acid present, for two parts of ferrous sulphate to the hundred thousand of water gave a result differing from the former by only one-ninth.

The presence of iodic acid in sea-water is further proved by precipitation with chloride of barium; when the precipitation is properly managed, the sulphate of barium carries down with it most of the iodic acid as iodate of barium. The precipitate must be formed in the cold, and but fractionally, the first precipitate being rejected; the best results are obtained when the first precipitate separates so much of the sulphuric acid as to leave just enough behind to give a slight *immediate* cloud with more barium salt. The first precipitate, ten or twelve hours being allowed for its formation before filtering, is perfectly free from iodate. Iodate of barium is slightly soluble in solution of chloride of barium, and therefore the least possible excess of barium salt should be used. The second precipitate, after washing, is boiled with a few c.c. of dilute solution of pure sulphate of potassium. After filtering, iodic acid may be detected in the filtrate by any of the methods in general use, or the filtrate may be evaporated to dryness and ignited at a low red heat, and iodine be detected in the residue by any of the methods applicable to the detection of iodine in an alkaline iodide.

When iodate of calcium is dissolved in dilute hydrochloric acid, a colourless solution is formed, smelling strongly of chlorine. Pure magnesium added to this liquid causes instant separation of iodine, which disappears but very slowly on addition of the reagents in even large excess. This reaction is the most delicate I have met with, for the detection of an iodate by the separation of the iodine in it, and the reaction is more persistent than with other reagents. A centimetre or so of fine pure magnesium wire added to 50 or 100 c.c. of sea-water, acidulated by a few drops of *pure* hydrochloric acid, with addition of a few drops of carbonic disulphide, and shaken up, gives, after a few minutes, a peach-blossom tinge to the disulphide. The reactions described as obtained with carbonic disulphide may be also obtained with starch, though less distinctly, owing to the slower action of the latter upon solutions containing but very little iodine.

It was stated in the first part of this note that sea-water taken before the mouth of the river issuing through Ramsey, and conveying sewage, contained its iodine in a free state. After ten days, however, the whole of the iodine had disappeared, and iodate of calcium was present as usual in sea-water taken some miles out from shore. The reaction of the water was neutral, and, on distilling, it did not, as it had done at first, give off any *trace* of sulphuretted hydrogen, nor any offensive smell. This change in the water took place in a well-stoppered bottle, and there was no indication of any gas having been formed. It was also stated that a specimen of water taken near the shore, at first free from uncombined iodine, contained free iodine after a few days. Organic matter in suspension could be observed in this water. After a few days more, however, the iodine disappeared, and the iodate reappeared, as in the former case. It is probable that the oxidation of iodine in changed sea-water, to iodic acid, takes place by intermediate stages of oxidation. Experiments already made confirm the conclusion arrived at by preceding investigators, that at least one oxide of iodine containing less oxygen than iodic anhydride may be formed, although it be unstable.

It will appear from what precedes that iodine is set free in sea-water wherever rivers, charged with offal and sewage, meet the sea. It would be reasonable to expect to find iodine in the atmosphere about such places. Winds would carry such iodine-charged air along with them, and rain falling while winds were blowing off any extensive areas of iodine volatilisation would contain iodine. Iodine has been found in rain-water, and it has also been sought for and not found. The conditions under which it might be expected to be found are now evident. Recently, a strong wind, accompanied with much rain, blew from the direction of Liverpool Bay (about 80 miles away); the rain-water contained iodine enough to give a recognisable reaction on shaking up 100 c.c. or so with carbonic disulphide. With the wind and rain from other quarters I have either detected no iodine, or had only a suspicion of its presence, the proportion being too small to give a certain reaction.

In my former note there was a curious misprint. In the paragraph describing a method of obtaining iodide of silver by the action of acetate of silver and hydrochloric acid on sea-water to which sulphite of sodium had been added, "*sodium* reaction" is put instead of "*iodine* reaction."

(To be continued).

THE DIFFERENCE BETWEEN BENZOLE AND BENZINE.

So much confusion prevails in consequence of the indiscriminate use of the words benzole and benzine, that it may be proper to state what these substances really are, and in what particulars they differ, and in what they are alike.

In the year 1825, Faraday discovered a peculiar liquid in the holders which at that time were used for conveying illuminating gas to private houses in London. He gave to it the name of bicarburet of hydrogen, and published a pretty full account of its properties. Nearly ten years afterwards, the Berlin chemist Mitscherlich produced the same substance from benzoic acid, and in allusion to its origin he proposed the name benzine. Liebig reprinted Mitscherlich's article in his "Annals," and in a foot-note remarks that, as the termination *ine* is too suggestive of strychnine, quinine, &c., bodies with which it has no analogies, it would be better to change the word into benzole, and this he accordingly did. It was thus that the word benzole was first introduced into our language. The French writers adhered to Mitscherlich's original name, and in their dictionaries we find the word benzine, while the English have adopted Liebig's proposition, and speak of benzole. We should have been spared much confusion if Faraday's original name had been retained by all parties.

It will thus be seen that, at the outset, benzole and benzine meant identically the same thing, but after the discovery of petroleum it was observed by chemists that the native rock oil was quite a different substance from the coal-tar product of the gas-house. The various hydrocarbons which can be distilled from petroleum have a different chemical composition, and vary in specific gravity and properties from the coal-tar products. Benzole has a fixed molecular composition; it is a true chemical compound, as much so as alcohol or water; its properties have been fully studied and described, so that on this point no doubts need prevail. On the other hand, the volatile substances which come over during the fractional distillation of petroleum are of a mixed and indefinite character, and it is difficult for chemists to agree upon a definite specific gravity, boiling-point, &c. By degrees it has become customary in the United States to call the liquid which has the sp. gr. of 62° to 65° Baumé ($=0·73$) benzine; the lighter hydrocarbons are called naphtha, rhigoline, and chymogene; the latter is condensed by pumps and is used for an ice machine. This class of liquids differ considerably from the true benzole of coal-tar; the latter has a sp. gr. of 0·85, and freezes at 37° F. The light oils of petroleum have never been frozen, and their sp. gr. is very low; any product of the distillation of petroleum having so great a sp. gr. as 0·85 (that of benzole) would be too thick to burn in a lamp, and could only be used for lubricating purposes. The solvent properties of benzole and benzine are analogous, though by no means identical; benzole rapidly dissolves asphaltum, while benzine scarcely attacks it; benzole is a better solvent of resins; benzole is far superior to benzine in carburetting air or gas for illuminating purposes. The most marked difference between the two exists in the fact that benzole can be converted by nitric acid into nitrobenzole, and by further treatment into aniline; whereas benzine from petroleum is not thus acted upon, and cannot be employed in the manufacture of aniline colours. Benzine can be readily ignited at a distance, while benzole must have the flame brought a little nearer; although it is volatile at all temperatures, and gives rise to explosive compounds. Benzole costs from six to eight times as much as benzine, according to the state of the market. Nearly all of the benzole of the world is sent to Germany to be there manufactured into aniline, from which are subsequently made the favourite aniline colours. It will thus appear that, although benzine and benzole started into life meaning one and the same thing, they have, in the course of time, come to be two widely different substances. Benzole is made from coal-tar, benzoic acid, and numerous other bodies, and can be converted into aniline. Benzine comes from petroleum, is very light cannot be frozen, and cannot be converted into aniline.

We find that the English, French, and German writers are beginning to recognise this distinction, and it will be better for all parties to agree upon what boiling-point, specific gravity, and chemical formula they will adopt for benzine. Benzole contains about 92·5 per cent carbon, and 7·5 per cent hydrogen; benzine is approximately composed of 84 per cent carbon, and 16 per cent hydrogen. In America, therefore, benzole and benzine mean different bodies of different origin, and having different uses.—*Scientific American.*

NEW RESEARCHES ON THE PHOSPHORUS BASES.*

By A. W. HOFMANN, LL.D., F.R.S.,
Professor of Chemistry in the University of Berlin.

About ten years have elapsed since I have submitted to the Royal Society, partly in conjunction with M. Cahours, a series of papers on the remarkable group of phosphorus compounds, the existence of which was first pointed out by M. Paul Thenard, as far back as 1847. These researches were devoted to the investigation of the *tertiary* and *quartary* derivatives of phosphoretted hydrogen, exclusively accessible by the methods then at our disposal. The study of the *primary* and *secondary* phosphines, the examination of which promised even more noteworthy results than that of the bodies previously investigated, still remained to be achieved.

New tasks of life have since that time presented themselves, and I have not been able to devote myself as much to research as in former days. Nevertheless, numerous attempts were made to procure the primary and secondary phosphines, which were clearly indicated by theory and partly even by M. Thenard's early observations. For a long time, however, these experiments proved unsuccessful, and it was only in the course of last summer that I at last discovered an easy method for their production. I may now fairly hope to complete an inquiry, the first part of which the Royal Society have done me the honour of inserting in the *Philosophical Transactions*; still some time will be required for surveying a field which appears to expand as one advances on its investigation, and I therefore beg leave to present to the Society the results of my inquiries in the measure as they are obtained, even before the whole investigation be terminated.

I. *Formation of Alcohol Phosphines by means of Phosphonium Iodide.*

The starting-point of the new series of researches was a lecture experiment. Wishing to exhibit to my class the decomposition of phosphoretted hydrogen by the spark current of an induction-coil, I was unable to procure by any of the methods hitherto described phosphoretted hydrogen of sufficient purity for this experiment. I was thus led to select a rather unusual substance as a source for phosphoretted hydrogen, viz., the beautiful compound of the latter with hydriodic acid, generally designated as phosphonium iodide. This substance, formerly accessible only with difficulty, may now be easily prepared in any quantity. If a slow stream of water, or better of potash

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* A paper read before the Royal Society.

or soda, be allowed, by means of a dropping tube to flow into a small vessel containing phosphonium iodide, a regular current of perfectly pure phosphoretted hydrogen is evolved, which may alone be introduced into an eudiometer provided with spark wires, and be submitted to experiment. With the first spark that passes, a brown cloud of finely divided phosphorus appears in the eudiometer, lining gradually the inside of the tube. After the lapse of five minutes, two volumes of phosphoretted hydrogen have become expanded into three volumes of pure hydrogen gas.

The facility with which phosphonium iodide is thus seen to split up into its constituents, hydriodic acid and phosphoretted hydrogen, led me to think that this body might be made available for the preparation of the compounds I had so long endeavoured to obtain. Two different processes suggested themselves, both aiming at a reproduction of the conditions under which, as I have shown now more than twenty years ago, the alcohol derivatives of ammonia are readily obtained. For this purpose it was necessary to disengage phosphoretted hydrogen in the presence of an alcohol iodide under pressure. This could be easily accomplished by submitting a mixture of an alcohol iodide and phosphonium iodide in sealed vessels to the action of an agent (such as water or a metallic oxide), zinc oxide for instance slowly decomposing the latter into its constituents. But this process appeared to be capable of a further simplification. Instead of withdrawing the hydriodic acid in the phosphonium iodide from the reaction by means of water or a metallic oxide, it seemed worth trying to utilise the acid in the production of the very alcohol iodide to be acted upon by phosphoretted hydrogen, and the question arose whether this result might not be readily attained by decomposing in so appropriate circumstances the phosphonium iodide by the alcohols themselves.

These several anticipations have been fully confirmed by experiment. Both processes yield alcoholic phosphines easily and copiously; and, remarkably enough, whilst the former (action of alcohol iodide upon phosphonium iodide) gives rise to the formation of exclusively the primary and secondary phosphines I had so long endeavoured to produce, the secondary process (action of the alcohols upon phosphonium iodide) furnishes only the tertiary phosphines and the quartary phosponium compounds previously known, but which may be much more easily and plentifully obtained by the new method. Phosphonium iodide has thus become a general agent for the production of the alcohol derivatives of phosphoretted hydrogen.

The formation of the several groups of phosphines by means of phosphonium iodide is represented by the following equations, in which the reaction is assumed to be accomplished in the methyl series.

Primary Phosphines.

$$2CH_3I+2(H_3P.HI)+ZnO=$$
$$=2[(CH_3)H_2P.HI]+ZnI_2+H_2O.$$

Secondary Phosphines.

$$2CH_3I+H_3P.HI+ZnO=(CH_3)_2HP.HI+ZnI_2+H_2O.$$

Tertiary Phosphines.

$$3(CH_3.HO)+H_3P.HI=(CH_3)_3P.HI+3H_2O.$$

Quartary Phosphonium Compounds.

$$4(CH_3HO)+H_3P.HI=(CH_3)_4PI+4H_2O.$$

II. *Primary and Secondary Methylic Derivatives of Phosphoretted Hydrogen.*

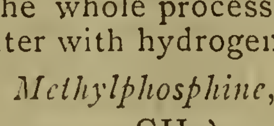
Owing to the superior interest attached to the monocarbon compounds, I was induced, in the first place, to test the new reactions in the methyl series.

Phosphonium iodide, methylic iodide, and zinc oxide act upon one another with remarkable facility. Two molecules of each of the iodides and 1 molecule of zinc-oxide were found to be appropriate proportions; the ordinary zinc-white of commerce may be employed.

Since it was desirable to procure at once the new compound in sufficient quantity for a thorough examination, the digestion-tubes received considerable charges. If these tubes have a capacity of from 120 to 150 c.c., 70 or 80 grms. of the agents involved in the process may be digested without danger. It is not, however, desirable to pass these limits. The compound first introduced is the phosphonium iodide, then follows the zinc oxide, which is compressed into a solid layer in order to prevent the methyl iodide, lastly poured in, rapidly to come in contact with the phosphonium compound. In the presence of zinc oxide the two iodides act upon each other even at the common temperature; and without this precaution it would be difficult to draw out and seal the tubes. Before heating, the tubes must be strongly agitated in order to produce a thorough mixture of the three substances. As regards the digestion, I have been often satisfied to work at the temperature of boiling water; after six or eight hours' exposure in a water-bath, the transformation is generally complete. If the tubes be heated to 150° in an air-bath, not more than four hours are required. On cooling, the digestion-tubes are found to contain a white crystalline solid; they invariably contain a good deal of compressed gas, so that some precaution is necessary in opening them before the blowpipe. The gases generally issue with a loud report; explosions, however, are but rarely met with. The proportions of the charges are so selected, that supposing the reaction to be complete, no other products, except methylphosphonium iodide and zinc iodide should be formed. But the presence of some are changed, phosphonium iodide, together with the escape of its constituents, more especially of phosphoretted hydrogen, prove at once that compounds more highly methylated must be formed. Experiment shows, however, that monomethyl and dimethylphosphine exclusively are generated. These two substances are easily separated from the crude product of the reaction, which, by means of a bent wire, may be removed in one piece from the tube.

The separation of monomethylphosphine and dimethylphosphine and the preparation of the two bodies in a state of purity, are based upon the observation that the salts of the former base are easily and thoroughly decomposed by water, whilst those of dimethylphosphine, more especially in the presence of free acid, may be considerably diluted without undergoing any change, but are immediately decomposed by addition of a fixed alkali. The crude product of the reaction is, therefore, consecutively treated with water and strong alkali, the former disengaging the methylphosphine, which, being gaseous, is collected in concentrated hydriodic acid, the latter liberating the dimethylated phosphine, which, being liquid at the common temperature, may be readily condensed by an appropriate cooler. The two bodies being powerfully acted upon by the oxygen of the air, the whole process is to be conducted in an appropriate filter with hydrogen.

Methylphosphine,



$$CH_5P=\left.\begin{matrix}CH_3\\H\\H\end{matrix}\right\}P.$$

Methylphosphine is a colourless transparent liquid of a most overwhelming odour.

Both by cooling and by pressure the gas may be condensed into a colourless liquid floating upon water, and boiling from platinum at −14° under a pressure of 0·7585 metre. The experiment was made with from 60 to 70 grms. of methylphosphine condensed in one operation, the boiling-point remaining constant till the last drop had distilled. In studying the behaviour of the new gas under the influence of increased pressure, I have availed myself of the beautiful compression-apparatus constructed by Gustav Magnus. At 0° 1¾ atmospheres were sufficient to start the liquefaction; under a pressure of 2½ atmospheres the gas was perfectly liquid, its purity being thus satisfactorily established. At 10° liquefaction commenced, and was completed under a pressure of 2½ and 4 atmospheres respectively. At 20°, lastly, under a pressure of 4 and 4½ atmospheres.

The volume-weight of methylphosphine gas was easily determined by allowing a small tube with a weighed quantity of the iodhydrate to rise into a graduated cylinder filled with mercury and inverted over the mercurial trough and subsequently introducing some concentrated solution of soda, which decomposed the salt. By observing the volume of the gas disengaged, all the data for fixing the volume-weight were given. In this manner the number 24·35 was found, the theoretical value being 24.

Methylphosphine is nearly insoluble in water; if the water contain air, part of the gas disappears, but only in consequence of oxidation, clearly indicated by the formation of white clouds. If the gas stand over water into which air can penetrate from without, the gas after some time is perfectly absorbed. Methylphosphine gas is rather soluble in alcohol even at its ordinary temperature, but more especially at temperatures approaching its point of liquefaction; at 0° one volume of alcohol of 95 per cent absorbs not less than twenty volumes; at the ordinary temperature ether dissolves but little. The solvent power increases, however, rapidly by evolving the liquid. At 0° one volume of ether is capable of dissolving seventy volumes of methylphosphine.

The methylated phosphorus base attracts oxygen with great avidity; on mixing the gas with air, white clouds are formed alone; but detonation does not take place at the common temperature. If methylphosphine be required of absolute purity, the gas must be allowed to escape from the apparatus until a small quantity collected over mercury remains perfectly transparent. The nature of the more immediate products of oxidation remains to be investigated. When gently heated in contact with air, methylphosphine takes fire. A glowing match, and even a glass rod just heated to scarcely visible redness, at once inflames the gas. In contact with chlorine and bromine over nitric vapours, it burns with a brilliant flame.

By its union with acids, methylphosphine gives rise to a series of well-defined salts distinguished by the remarkable property of being decomposed by water. On this property is based the preparation of the body in a state of purity. The salt bleaches vegetable colours like chlorine.

Of the salts, two only have as yet been more closely examined, the chlorhydrate and the iodhydrate.

Chlorhydrate.—If a current of methylphosphine gas be conducted into strong fuming hydrochloric acid, it is perfectly absorbed; no crystals, however, are separated; but on mixing the two gases, they are at once condensed to beautiful, well-formed, four-sided plates. In certain reactions with organic chlorides, which are accomplished in ethereal solution, and which I hope to describe more minutely to the Society hereafter, the salt is disposed in splendid large four-sided tables, which are often a centimetre in diameter. The chlorhydrate is so volatile that it passes over even with the vapour in feathers. Analysis was performed by the methods often adopted for demonstrating the composition of sal-ammoniac in lectures. By allowing equal volumes of methylphosphine and hydrochloric gases to meet over mercury, both entirely disappear with formation of a crystalline deposit. Hence the salts contain $CH_6PCl = (CH_3)N_2P,HCl$. The solution of the chlorhydrate in concentrated hydrochloric acid furnishes with platinum perchloride a beautifully crystallised orange-red platinum salt.

Iodhydrate.—Of all the salts of the base, this is the one most readily obtained; it separates in bulky crystals when a current of methylphosphine is passed into the most concentrated iodhydric acid. If a solution of the gas in somewhat less concentrated iodhydric acid be mixed with ether, the whole liquid solidifies to a mass of iridescent plates. By washing with ether, pressing, and sublimation in a current of dry hydrogen, the salt may be readily obtained in a state of purity. Analysis led to the formula $CH_6PI = (CH_3)H_2P,HI$.

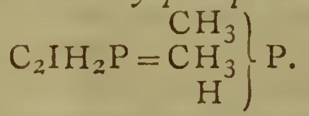
The *sulphate* I have not yet seen in the solid state; it is, however, readily formed by bringing the phosphorus base in contact with concentrated sulphuric acid. The gas is absorbed without the acid colouring. On addition of water, methylphosphine is again liberated. The *sulphite* is a white amorphous mass, which is formed when methylphosphine and sulphurous acid gases are collected together over mercury.

With carbonic acid and sulphuretted hydrogen methylphosphine gas may be mixed without any condensation taking place. Sulphur, carbon bisulphide, and chlorocarbonic ethers, when placed in contact with methyl-phosphine, give rise to the formation of new compounds, which will be the subject of a special communication.

Among the products M. P. Thenard* describes in the short notice of his researches on the "Action of Methylic Chloride upon Calcium Phosphide," is an oily compound boiling at 250° containing C_2H_6P (perhaps phosphoric iodine), which, when treated with water, splits into an acid and a gaseous body. The latter, to which M. P. Thenard assigns the formula CH_4P, is said to combine with either one or two volumes of chlorhydric gas. It can scarcely be doubted that the phosphoretted gas discovered by M. Thenard is the same body, the chemical history of which I have endeavoured to sketch in this paper. There are certainly still some discrepancies to be explained, such as the observations just alluded to, that M. Thenard's equation combined with chlorhydric acid in two proportions.

The somewhat complex reaction which gives rise to the formation of methylphosphine, when generated by means of methylic chloride and calcium phosphide, and, indeed, the difficulties attending the process, which appear to have prevented M. Thenard from pursuing the line of research, have hitherto deterred chemists from entering more thoroughly into the investigation of this remarkable compound. By the method described in this paper, methylphosphine may be readily and abundantly obtained in a state of perfect purity, so that its further examination will present no difficulty.

Dimethylphosphine,



$$C_2IH_2P = \left.\begin{matrix} CH_3 \\ CH_3 \\ H \end{matrix}\right\} P.$$

The method of preparing dimethylphosphine has been already stated. It is a transparent colourless liquid, which, when protected from the atmosphere, may be preserved without change. It is lighter than water, in which it is insoluble; alcohol and ether, on the other hand, dissolve it with facility. Its boiling-point is 25°.

Dimethylphosphine is remarkable for the avidity with which it attracts oxygen, and which is infinitely superior to that of the monomethylated base. In contact with the air, it instantaneously takes fire and burns with a powerfully luminous phosphorus flame. If the hydrogen atmosphere in which it is prepared contain only traces of air, the presence of which is at once indicated by the formation of white fumes in working with this compound, even if great care be employed, violent and by no means dangerless explosions are occasionally experienced.

Dimethylphosphine easily unites with acids; all the salts are exceedingly soluble. The solution of the chlorhydrate furnishes with platinum perchloride a fine crystalline salt. The base also unites with sulphur and carbon bisulphide. The compounds thus formed are not yet investigated; but it may even now be remarked that they essentially differ from those produced by trimethylphosphine, more especially in their deportment with carbon bisulphide, a marked discrepancy is observed. Dimethylphosphine in this case produces no crystalline compound similar to those which are formed with the tertiary phosphines; so that the absence of trimethylphosphine among

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* *Comptes Rendus*, vol. xxvi., p. 892.

the products of the action of methyliodide on phosphonium iodide may be readily demonstrated.

The inflammability and the low boiling-point of dimethylphosphine render it difficult to work with this body except in the winter season. The examination of its numerous products of decomposition, which promises to be fruitful in results, is, therefore, as yet but little advanced. Hitherto I have studied somewhat more in detail only the products of oxidation of the methyl bases, which I beg leave to describe to this Society in a special paper.

(To be continued).

THE SUCCESSIVE ACTION OF SODIUM AND IODIDE OF ETHYL ON ACETIC ETHER

CRITICALLY EXAMINED AND INTERPRETED ON THE PRINCIPLES OF THE TYPO-NUCLEUS THEORY.

By OTTO RICHTER, Ph.D.

(Concluded from p. 221.)

Part III.

I shall resume the thread of my narrative by dilating on the various species of ketones which are engendered in the destructive distillation of these substances, and briefly explain the nature of the molecular changes which accompany their formation. I shall then endeavour to prove, by a variety of collateral experimental evidence, that the two most conspicuous members of these series, viz., Frankland's ethaceton-carbonic ether and Wanklyn's ethyl-triacetyl, are really constructed upon two distinct chemical types or patterns, and that these differences in constitution are rendered manifest by their general chemical deportment, as well as by the nature of the products of their destructive distillation. I shall finally subjoin a synoptical arrangement of chemical formulæ, exhibiting the genetic relations between Frankland's and Wanklyn's series on the one hand, and the lactyl series on the other hand.

Let us then, in the first place, inquire into the nature of the molecular changes when the baryta salts of these different acetic ether derivatives are subjected to the process of destructive distillation. In Frankland's series, the chief products of the reaction are found to be carbonic acid and a so-called ketone, the composition of which varies with that of the generating baryta salt. In Wanklyn's series, the only substance which appears to have been examined in this respect is the barium-triacetyl, which, on being heated with baryta water, splits up into carbonic acid, acetone, and *ethylic alcohol*, while the corresponding ethaceton-carbonate of baryta furnishes, by the same treatment, carbonic acid and a ketone, but *not a trace of ethylic alcohol.* From this striking and significant fact the conclusion seems to me inevitable, that these two acids are not identical, but isomeric only. Indeed, after examining more closely into these relations, I have come to the conclusion that the presence of alcohol among the products of their destructive distillation is a characteristic feature of Wanklyn's compounds, while the absence of alcohol among these products is a characteristic feature of Frankland's compounds. But in order to comprehend the precise nature of these reactions, it is requisite that I should first of all explain the formation of the ordinary acetone. The principal stages of this process, which requires the co-operation of 2 molecules of acetate of baryta, may be briefly described as consisting—(1) in the re-solution of one of these molecules into peroxide of barium, Ba_2O_4, and oxy-acetyl, $2H_3C_2 ; 2C_2O_2$; (2) in the immediate reduction of this peroxide by the oxalic acid of the other molecule of acetate of baryta; (3) in the breaking up of the resulting peroxide of acetyl, $2H_3C_2 ; 2C_2O_4$, into 2 molecules of carbonic acid and 1 molecule of methyl, which, by its union with the methyl-adjunct of the aforesaid oxyacetyl, gives rise to 1 molecule of acetone, with the formula $2(H_4C_2 : H_2C_2) ; 2C_2O_2$. Similarly, when ethaceton-carbonate of baryta is distilled with baryta water, it resolves itself, in the first stage, into a molecule of acetate of baryta, which is derived from the colligated deacetylic alcohol, and a molecule of ethacetate of baryta; in the second stage, the ethacetate of baryta breaks up into oxyethacetyl, $2(H_6C_4 : HC_2) ; 2C_2O_2$, and peroxide of barium, which is immediately reduced again by the oxalic acid of the co-operating acetate of baryta, with production of peroxide of acetyl; in the third stage, the peroxide of acetyl splits up into 2 molecules of carbonic acid and 1 molecule of methyl, which instantly unites with the hydrocarbon adjunct of the aforesaid oxyethacetyl, with production of a molecule of ethacetone, whose formula is therefore $2(H_6C_4 : H_2C_2 : H_2C_2) ; 2C_2O_2$. As regards the diethacetone, which is originated in the destructive distillation of the diethaceton-carbonate of baryta, and to which I assign the formula—

$$2(H_6C_4 : H_4C_4 : H_2C_2 : H_2C_2) ; 2C_2O_2,$$

its formation is so completely analogous to the former, that the reader will find no difficulty in analysing it for himself. It is worthy of note that these two species of complex ketones are produced by the co-operation of two different acids, one of which contains a simple, and the other a complex, hydrocarbon-adjunct; and my analysis has further revealed the interesting fact that it is the former of these acids which has undergone the process of dissociation. I shall, in the next place, delineate the various stages of the process which accompany the destructive distillation of Wanklyn's barium-triacetyl with baryta water. In the first stage, 1 molecule of hydrate of baryta, after effecting the separation of the deacetylic alcohol, conspires with it in the production of 1 molecule of acetate of baryta, while butyrate of baryta remains. In the second stage, the butyrate splits up into acetite of baryta and deethylic alcohol, whereupon, under the influence of the baryta base, 2 molecules of water become decomposed, the liberated oxygen being employed in the conversion of the acetous acid into acetic acid, while the liberated hydrogen accomplishes the conversion of the deethylic alcohol into ethylic alcohol. In the last stage, the two differently regenerated molecules of acetic acid will then co-operate towards the formation of acetone and carbonic acid, in the manner previously explained. I shall now draw the reader's attention to another set of experiments, from which I expect to gain additional strong evidence in support of my view of the chemical constitution of Wanklyn's ethyl-triacetyl. I shall analyse, for this purpose, an experiment which was devised by Professor Wislicenus, in the hope of transforming Geuther's diacetic ether (Frankland's aceton-carbonic ether) into β oxybutyrate of soda by the combined action of water and sodium amalgam. In this process no hydrogen gas is disengaged, and the resulting products are hydrate of soda, oxybutyrate of soda, and ordinary alcohol, clearly showing that the hydrogen which is liberated in the first stage, according to the equation—

$$2Na_2+4H_2O_2=2(H_2O_2.Na_2O_2)+2H_2,$$

combines directly with the carbon-adjunct of the colligated deacetylic alcohol, with production of acetylic alcohol, that an interchange of metals takes place in the second stage between the sodium nucleus of one of the two newly-formed hydrates of soda, and the ethyl nucleus of the newly-formed oxybutyric ether, the resulting products being alcohol and oxybutyrate of soda. The reader cannot fail to perceive that the oxybutyric acid of Wislicenus, and the butyric acid of Wanklyn, are heterologues of the same family group, and that, with the aid of oxidising agents, it should be possible to obtain the former from the latter. The foregoing experiment is interesting in this respect also, that it illustrates one of the modes of transition from compounds belonging to Frankland's series, to compounds belonging to Wanklyn's series. It is, moreover, worthy of note, that not only hydrogen, but bromine likewise, possesses, according to Lippmann, the faculty of combining directly with the aceton-carbonic ether. Now, it is generally admitted, that when bromine is made to act on a genuine hydrocarbon-adjunct, two molecules of this element invariably conspire, the one to take the place of the eliminated hydrogen, the other to unite with it under the form of hydro-bromic acid; but what will happen when there is no hydrogen to displace,—in other words, when the hydrocarbon-adjunct is represented by one of the more or less condensed carbon molecules? The answer to this question becomes perfectly intelligible if we assume, that when bromine is simply absorbed by a given organic molecule, it has, like hydrogen, entered into direct chemical union with one of these condensed carbon-adjuncts. Applying this view to the present case, the formula of bibromaceton-carbonic ether will be—

$$\frac{H_2O_2. \qquad 2H_4C_4 ; H_2O_2.}{2C_4Br_2 ; H_2O_2 : 2H_3C_2 ; 2C_2O_3}$$

and it may consequently be regarded as oxybutyric ether, in which the hydrogen of the colligated alcohol has been displaced by bromine. Trusting that the here suggested connection between these two acids will soon form the subject of experimental research, I shall pass on to consider two other equally curious compounds, which Lippmann obtained by the successive action of corrosive sublimate and bromine on sodaceton-carbonic ether. The first of these bodies bears the name, dimercuraceton-carbonic ether, and the second the name, bibromdimercuraceton-carbonic ether. The former compound is produced according to the equation—

$$\frac{H_2O_2. \qquad 2H_4C_4 ; H_2O_2.}{2C_4 ; H_2O_2 : 2H_2NaC_2 ; 2C_2O_3} + Hg_2Cl_4 =$$

$$\frac{H_2O_2. \qquad 2H_4C_4 ; H_2O_2.}{2C_4 ; H_2O_2 : 2HHgC_2 ; 2C_2O_3} + H_2Cl_2 + Na_2Cl_2 ;$$

the first stage consisting in the reduction of the perchloride of mercury to the protochloride by 1 molecule of methylic hydrogen, and the second stage in the reduction of the protochloride to metallic mercury by 1 molecule of methylic sodium, while the liberated mercury unites with the residual formyl-adjunct, making it appear as if 1 molecule of hydrogen and 1 molecule of sodium had been displaced by 1 molecule of mercury only. The latter compound is evidently produced from the former by the direct union of bromine with the condensed carbon adjunct, $2C_4$, and requires no further comment.

Having now completed my inquiry into the genetic relations and chemical constitution of the two series of compounds and derivatives, which the admirable researches of the two great London chemists have brought to light, I have deemed it advisable, for the special consideration of those among my readers who feel disposed to prosecute their chemical studies in the spirit of the "typo-nucleus" theory, to append a synoptical arrangement of chemical formulæ, grouped together in accordance with the combined principles of identity of type and homology. My immediate object is to exhibit the intimate genetic relations which obtain between the members of Frankland's and Wanklyn's series on the one hand, and the members of the lactyl series on the other hand; but in order to render the whole scheme more complete and instructive, I have joined thereto the members of the formyl and glycolyl series also. It is scarcely necessary to remind the reader that the terms formyl, glycolyl, lactyl, &c., terms which are borrowed from the "typo-radical" theory, bear a widely different meaning in the "typo-nucleus" theory. They represent, in fact, the plain or non-enveloped twin-carbon-nuclei, variously modified by the accession of hydrocarbon- or halogen-adjuncts, and each of which, under the combined influence of bases and oxygen, gives rise to three heterologous acids, which seem to be so constituted, as if 1, 3, or 5 univalent oxygen molecules were stored up in the envelope of each single component carbon nucleus. In harmony with the common practice, the water salts of these three heterologues are distinguished from each other by means of different vowels, and, to save space, they are here embodied in the same formula. Thus, for instance, the formite, formate, and formoate of water, are expressed by the collective formula—

$$\frac{H_2O_2.}{2H ; 2C_2O_{\substack{3\\5}}}.$$

Table of Genetically-Related Water-Salts.

Formyl Type.

Formyl = $2H ; 2C_2$.

i Form-a-te . . . . . . oa	$\frac{H_2O_2.}{2H ; 2C_2O^3_5}$
i Acet-a-te . . . . . . oa	$\frac{H_2O_2.}{2H_3C_2 ; 2C_2O^3_5}$
&c.	&c.

Lactyl Type.

Lactyl = $2H_2C_4 ; H_2O_2 : 2H ; 2C_2$.

i Lact-a-te . . . . . . oa	$\frac{H_2O_2. \qquad H_2O_2.}{2H_2C_4 ; H_2O_2 : 2H ; 2C_2O^3_5}$
i Acelact-a-te . . . . . . oa	$\frac{H_2O_2. \qquad H_2O_2.}{2H_2C_4 ; H_2O_2 : 2H_3C_2 ; 2C_2O^3_5}$
&c.	&c.

Glycolyl Type.

Glycolyl = $2C_2 ; H_2O_2 : 2H ; 2C_2$.

i Glycol-a-te . . . . . . oa	$\frac{H_2O_2. \qquad H_2O_2.}{2C_2 ; H_2O_2 : 2H ; 2C_2O^3_5}$
i Aceglycol-a-te . . . . oa	$\frac{H_2O_2. \qquad H_2O_2.}{2C_2 ; H_2O_2 : 2H_3C_2 ; 2C_2O^3_5}$
&c.	&c.

Pyruvyl Type.

Pyruvyl = $2C_4 ; H_2O_2 : 2H ; 2C_2$.

i Pyruv-a-te . . . . . . oa	$\frac{H_2O_2. \qquad H_2O_2.}{2C_4 ; H_2O_2 : 2H ; 2C_2O^3_5}$
i Acepyruv-a-te . . . . oa	$\frac{H_2O_2. \qquad H_2O_2.}{2C_4 ; H_2O_2 : 2H_3C_2 ; C_2O^3_5}$
&c.	&c.

Alconyl Type.

Alconyl = $2H_2C_4 ; H_2O_2 : 2C_4 ; H_2O_2 : 2H ; 2C_2$.

i Alcon-a-te . . . . oa	$\frac{H_2O_2. \qquad H_2O_2. \qquad H_2O_2}{2H_2C_4 ; H_2O_2 : 2C_4 ; H_2O_2 : 2H ; 2C_2O^3_5}$
i Acetalcon-a-te . . . . oa	$\frac{H_2O_2. \qquad H_2O_2. \qquad H_2O_2.}{2H_2C_4 ; H_2O_2 : 2C_4 ; H_2O_2 : 2H_3C_2 ; 2C_2O^3_5}$
&c.	&c.

On comparing the formulæ of this table with those of the text, the reader will not fail to perceive that the acelactite of water is identical with Wanklyn's butyrate; the acelactate of water with Wislicenus's β oxybutyrate; the acepyruvate of water with Frankland's aceton-carbonate; and the acetalconite of water with Wanklyn's hydrogen-triacetyl. As regards the pyruvate of water, from which the leading type derives its name, its easy conversion into lactate of water by means of nascent hydrogen, furnishes additional strong evidence of the correctness of its formula, which is based upon an analysis of the molecular changes accompanying the destructive distillation of tartaric acid.

I am, of course, ready to admit that several of the compounds enumerated in the preceding scheme have not yet been isolated; nevertheless, when I ponder the great weight and conclusiveness of the experimental evidence which I have been able to bring forward with reference to those which are really known; when it is seen, moreover, that this whole network of chemical formulæ is spun, as it were, out of one thread and woven into a design of high intrinsic beauty and symmetry, I think I may safely affirm, but I do so without boasting, and in all humility, that the critical method of the "typo-nucleus" theory surpasses in its rationality, as well as in its results, the dogmatical method of the "typo-radical" theory. In taking leave of my subject, I feel it my bounden duty thus publicly to express my deep obligations to all those chemists who, even though it was done without their knowledge and consent, have never ceased to supply me with materials for continuing my speculative travels. I can assure these gentlemen, and above all, Professor Frankland and Mr. Wanklyn, that nothing will give me greater satisfaction than to learn that, notwithstanding the antagonism of our present chemical convictions, they have each and all derived a certain amount of intellectual pleasure from my narrative of the adventures of sodium among the acetic ether molecules.

THE HENDERSON PROCESS FOR THE REMOVAL OF PHOSPHORUS FROM IRON.

The inventor claims that, by this process, phosphorus may, as a rule, be removed from all kinds of British pig-iron that are smelted from ores (as distinguished from cinder pig smelted from common puddling furnace cinder) in sufficient amount to render the iron pure enough for steel. This fact was demonstrated by trials at the Blockhairn Iron Works, in Glasgow. At a trial made on the 23rd December last, No. 4 Dalmellington pig-iron was treated, the analyses of the pig-iron and results as regards phosphorus, by Mr. Edward Riley, are—

Pig-iron, phosphorus per cent	1·14
Refined cast-iron 30 mins. after fusion ..	0·23
,, ,, 40 ,, ,, ..	0·15
,, ,, 50 ,, ,, ..	0·12
Wrought-iron..	0·07
The cinder	0·52

360 lbs. pig-iron, 100 lbs. ilmenite, 10 lbs. manganese, and 42 lbs. of fluoride of calcium were used.

The complete analysis of the cinder is—

	Per cent.
Silica	11·12
Titanic acid	5·02
Protoxide of iron	56·41
Peroxide of iron	18·20
Alumina	1·73
Protoxide of manganese	2·22
Lime	3·51
Magnesia..	0·43
Phosphoric acid	1·19*
Sulphur	0·09
Nickel	trace
	99·92
Metallic iron	56·62

* = 0·52 per cen phosphorus.

The pig-iron smelted from cinder of the above composition will contain all the phosphorus in the cinder, which will be 0·87 per cent in the pig-iron, or 0·27 per cent less than the original pig-iron smelted from ore.

It is obvious that as the phosphorus is not all in the cinder that was removed from the iron, it must have become volatilised. It is worthy of remark that the calcium and manganese have also been volatilised.

We understand that iron (No. 1 or puddled bar rolled direct from bar or bloom as taken from the furnace) made on the 7th inst., in the presence of a committee of scientific men has been tested at Mr. David Kirkaldy's works, and found to stand a higher test than any iron previously examined.

NOTICES OF BOOKS.

Elements of Chemistry; Theoretical and Practical. By William Allen Miller, M.D., D.C.L., LL.D., late Professor of Chemistry in King's College, London. Revised by Herbert McLeod, F.C.S., Professor of Experimental Science, Indian Civil Engineering College, Cooper's Hill. Part I.: Chemical Physics. Fifth edition, with additions. London: Longmans and Co., 1872.

In this new edition of what has long been a standard text-book of chemistry, we find much that had become a necessary addition, owing to the rapid progress made by recent research in some branches of physical science. During the last year solar chemistry, for instance, has visibly developed from day to day; while, since the fourth edition of this work was issued from the press, much has occurred to modify as well as to extend our views of the theory of atomicity. Professor McLeod has been very happy in the selection of his first addition to permanent chemical literature since his acceptance of the chair of experimental science at Cooper's Hill; and is to be congratulated on the manner in which he has fulfilled a difficult task. We must not forget that the later editions had the personal revision of the talented Dr. Miller, and we cannot pass a higher compliment than to say it is difficult to detect, except by direct comparison, where the additions have been made. The work is more than ever entitled to its first rank in the literature of elementary chemical science, and we anticipate the publication of the remaining volumes.

CORRESPONDENCE.

ESTIMATION OF SUPERPHOSPHATE.

To the Editor of the Chemical News.

Sir,—I shall be glad if the following paper should find space in your valuable journal.

I may observe that, being recently associated with the Chemical Society, I addressed it to the President, under the hope that its commercial, if not its scientific, importance, might make it worthy of notice and discussion, but I am politely informed by the Secretary that, as the subject involves no *chemical novelty*, it is not suitable for the Chemical Society. Probably, if this matter gets well before the public, this Society may form a different judgment; if pure and disinterested science will not help us, where are we to look for aid? Fortunately, all matters of sufficient public importance have always a superior power in reserve, and to this, the Press, I now appeal.—I am, &c.,

W. Little.

TO DR. FRANKLAND, PRESIDENT OF THE CHEMICAL SOCIETY OF GREAT BRITAIN.

On the Important Discrepancy existing between Chemists of repute in the Analysis of the Artificial Manure known as Superphosphate of Lime, for the Determination of the Percentage of Tribasic Phosphate of Lime rendered soluble by Acid, popularly known as "Soluble Phosphate."

Sir,—I hope the question which I bring before the notice of the Members of the Chemical Society through you, as their able and honourable President, besides its great commercial interest, may have sufficient scientific interest to engage their earnest attention.

If I do not mistake the object of the Chemical Society, I should say any large branch of manufacture in which the science of chemistry is much involved, and especially when such manufacture has for its purpose the increase of the food-producing power of agriculture, must be a subject worthy of the serious consideration of the distinguished members of one of the most important of our scientific and learned societies.

Within the last few years Agricultural Associations have done much in dispelling the mystery which for so long had enshrouded the trade, manufacture, and use of artificial manure; the custom is now general amongst farmers acting under the advice of honourable chemists, to purchase these manures for certain well-known and intrinsic qualities, determined by the careful analysis of experienced analytical chemists. Amongst the artificial manures which take pre-eminence before all others, stands superphosphate of lime. The composition of this manure is now well understood by farmers, and a long experience has proved the various ways in which it may be profitably employed; it is manufactured on an immense scale in many parts of Great Britain, the present demand for agriculture probably amounting annually to hundreds of thousands of tons.

In the purchase of this manure by one of the largest and most successful associations in England—the Lincolnshire Farmers' Association—the rule is to purchase by public tender, for ready money, under a guarantee that the manure shall contain, at the time of delivery, 26 per cent of "soluble phosphate;" or, more scientifically, tribasic phosphate of lime rendered soluble by acid, and without reference in any degree to any other matter that may be contained, either as precipitated or insoluble phosphates, &c.; and, in the case of any dispute, it shall be decided by the report and analysis of the chemist for the time being of the Royal Agricultural Society, whose decision shall be final.

It is with reference to the determination of this so-called soluble phosphate by chemists of established repute that agriculture has such just reason to complain: the great discrepancy which exists, not occasionally, *but as a rule*, between eminent analytical chemists leads to so much confusion and misunderstanding, if not to say fraud, that, unless some more stringent and reliable system can be uniformly adopted, the present analytical reports are in a certain degree good for nothing but to promote discord and suits at law.

The following is a recent example of the great discrepancy existing between two chemists, A and B, of established repute; the samples were exactly alike and were sent for analysis at the same time:—

	Sample No. 1, percentage.		Sample No. 2, percentage.	
	A.	B.	A.	B.
Biphosphate of lime, equal to bone phosphate or tribasic phosphate of lime, rendered soluble by acid	20·46	17·64	23·60	19·54
Precipitated phosphate of lime	2·43	—	—	—
Insoluble phosphate of lime	8·10	11·60	8·26	10·70

Hitherto I am inclined to believe that the attention of the purely scientific chemists as a body has not been sufficiently impressed with the scientific and commercial importance of this discrepancy between analysts; but, the fact being known, it is to be hoped some really practical plan will be put into operation to promote a remedy for this scientific scandal and case of agricultural grievance.

The members of our Association are requested to send fair samples of every lot of manure they receive, which are analysed for *soluble phosphate only* by our own local chemist; and occasionally, and always in the case of dispute, samples are sent to the chemist of the Royal Agricultural Society; and as this discrepancy between analysts is a difficulty which has recently cropped up, similar samples are sent to other well-known chemists for the satisfaction of our contractors. And with what result! A difference in their reports, as a rule, of 3 per cent, and sometimes more than 4 per cent, in soluble phosphate, or, in money value, 10s. per ton, a sum small in itself, but when multiplied by 6000, the number of tons of manure distributed by our Association this season, shows an amount of £3000, or 14 per cent on the cost of the manure, and considerably more than what would be a fair manufacturing profit for ready money. But, if all this can occur with an association that uses every kind of vigilance to protect the interests of its members, what must be the consequence with the great body of agriculturists, who, standing alone, have no power to defend themselves against these mischievous discrepancies amongst chemists and *errors* on the part of manure makers. I do not hesitate to say the sum might be expressed by hundreds of thousands of pounds on all the manure used in one year; and whether all this is to come out of the pockets of farmers depends upon the choice of the *high* or *low* analyst as the scientific umpire.

I believe it is not difficult to find a remedy for all this, and, if I may be allowed, I would suggest that samples of superphosphate should be taken by a committee and sent for analysis to a certain number of purely scientific chemists, that the reports sent by these gentlemen should be accompanied with an exact description of the process of analysis employed, and that the scientific committee of chemists, after full consideration, should select that process which should be adopted as a standard for the future guidance for chemists, and by which all commercial disputes and transactions should be settled.

In addition to this question of the discrepancy between analysts, it may be well to refer to another objectionable feature which certain manufacturers and chemists are endeavouring to introduce: I mean what is recently called "precipitated phosphate," and this is done in direct opposition to the advice of the Royal Agricultural Society's chemist, who emphatically tells farmers to *pay only for soluble phosphate*. The following letter, recently received from Dr. Voelcker on this subject, so completely accords with the rule adopted from the commencement by the Lincolnshire Farmers' Association, that I commend it to the earnest attention of chemists and our members.

"Analytical Laboratory, 11, Salisbury Square,
"Fleet Street, London, E.C.
"March 16, 1872.

"Sir,—I have the pleasure of enclosing results of analysis. Your telegram is not quite clear, but I presume you wish me to ascertain what proportion of the insoluble phosphates in the superphosphate occurs as precipitated. This I cannot tell you, for there is no reliable plan of determining the percentage of precipitated phosphates. Precipitated phosphates are insoluble in water, and although more valuable than even insoluble bone phosphate, yet these nice distinctions only serve to encourage doubtful transactions on the part of sharp dealers, and cause confusion in business transactions.

"The business of the manufacture of mineral superphosphates is to render soluble mineral phosphates, and if he performs his work badly and chooses to use cheap materials full of oxide of iron, which causes the portion of the soluble phosphates to go back, or, in other words, to become precipitated, he must do so at his own risk. My advice to purchasers of mineral superphosphates is, and always has been, to buy mineral phosphates by the percentage of soluble phosphate at a fixed price per unit, and to take no account of the insoluble phosphates in such superphosphates, and to discard entirely what the maker or dealer may say about precipitated phosphates.

"I do not, as a rule, give any valuation of manures.—Yours faithfully,

"AUGUSTUS VOELCKER."

One other little grievance before I conclude. I protest against analytical chemists taking upon themselves to fix a value to manures. Nothing can be more absurd. Any business man knows that the value must fluctuate with the market price of the materials used, modified also by the process employed, and also by the conditions of purchase; it would be just as reasonable to fix the price of indigo, soap, soda, or any other manufactured commodity; besides, I observe some chemists estimate that "soluble phosphate" is worth four shillings per unit, whilst our Association actually supplies it at nearly half this price, or two shillings per unit or per cent, when the cost of carriage and the value of other materials are deducted.

The committee of the Lincolnshire Farmers' Association have had to contend with many unforeseen difficulties since its formation in 1868, but time, patience, and a firm determination will, I feel confident, soon bring everything into good working order.

In conclusion, I only ask farmers and our members to stick to one another, and always bear in mind our best friends are not to be found outside the circle of the Lincolnshire Farmers' Association.

I am, Sir,
Your obedient servant,
WM. LITTLE.

The Hall, Heckington,
Lincolnshire.

THE CHARCOAL RESPIRATOR.

To the Editor of the Chemical News.

SIR,—I am glad to be able to inform you that the charcoal respirators invented by me in 1854 are now coming into general use, especially in manufactories and laboratories. They have been found peculiarly efficacious in protecting workmen from mercurial and other noxious metallic fumes, and have been largely employed for that purpose by the Borneo Company in their quicksilver works at Sarawak, and also by Messrs. Johnson and Matthey. They have also been found very useful in absorbing the fumes of chloride of sulphur so largely used in vulcanising india-rubber, and in stopping hydrochloric acid and sulphurous acid gases, and also the vapours of bromine and iodine.

They do not effectually stop chlorine, but I have recently found that they may be made to do so in the following simple manner:—The respirator is suspended for ten or fifteen minutes over some strong solution of ammonia in a large beaker; in this way the charcoal absorbs a very large amount of ammoniacal gas. It is then taken out and exposed to the air for a short time until the excess of ammonia has been removed, when it will be found that the wearer can remain for a considerable time in an atmosphere containing chlorine without suffering any inconvenience.—I am, &c.,

JOHN STENHOUSE.

The Laboratory, 17, Rodney Street,
Pentonville, N.

NOTES AND QUERIES.

Superphosphate of Lime.—I shall be obliged if your readers will kindly inform me of the newest and best books treating of the manufacture of superphosphate of lime, with price and publisher if possible. —OMEGA.

University of Freiberg.—Your correspondent "Undergraduate" inquires as to Freiberg University. As an old Giessen student in the subjects named by your correspondent, I would recommend Freiberg for geology, mineralogy, chemistry, especially if allied with metallurgy. Giessen has much to recommend it: Professor Will, in the chair of Chemistry, being noted for the personal care he bestows on each student, an advantage of smaller universities over such as Berlin, Heidelberg, or Leipzig. The terms, I believe, in all the German universities begin about the second week in October, and in the winter session the courses begin at the rudiments of inorganic chemistry, not organic, and soon in other subjects. Personal prejudice would lead me to recommend Giessen; its collateral advantages, especially to a foreigner, are great. If "Undergraduate" wants more information I shall be happy to afford it to him, and I enclose my private address.—J. F. A., F.C.S.

MEETINGS FOR THE WEEK.

MONDAY, May 20th.—Anthropological, 8.
TUESDAY, 21st.—Civil Engineers, 8.
—— Royal Institution, 3. E. B. Tylor, F.R.S., "On the Development of Belief and Custom amongst the Lower Races of Mankind."
—— Zoological, 9.
WEDNESDAY, 22nd.—Society of Arts, 8.
Geological, 8.
THURSDAY, 23rd.—Philosophical Club, 6.
—— London Institution, 7.30.
Royal Institution, 3. Dr. Tyndall, LL.D., F.R.S. "On Heat and Light."
FRIDAY, 24th.—Royal Institution, 9. Prof. Clifford, "On Babbage's Calculating Machine."
—— Quekett Microscopical Club, 8.
SATURDAY, 25th.—Royal Institution, 3. Prof. Roscoe, F.R.S., "On the Chemical Action of Light."

TO CORRESPONDENTS.

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The Physiological and Therapeutical Action of the Bromide of Potassium and Bromide of Ammonium. In Two Parts. By Edward H. Clarke, M.D., and Robert Amory, M.D. Boston: James Campbell.

Report of Chemical Department of Geological Survey for the Year 1870. By T. G. Wormley. Columbus: Nevins and Myers.

A Manual of Chemical Physiology, including its Points of Contact with Pathology. By J. L. W. Thudichum, M.D. Longmans and Co.

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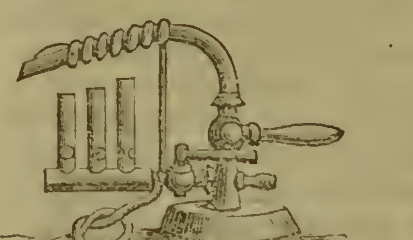

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THE CHEMICAL NEWS.

Vol. XXV. No. 652.

ON THE PRESENCE OF IODATE OF CALCIUM IN SEA-WATER.

By E. SONSTADT.

(Concluded from page 232).

The experiments now to be described were made upon water kindly procured for me by my friend, Mr. Spanton, from Ramsey Bay, at a distance of about three miles from the shore. The sp. gr. of the water was 1·0265 at 13°. A number of attempts were made to distil off the iodine from quantities of from 400 to 600 c.c. of the sea-water, after addition of reagents intended to set the iodine free. It was not found possible to obtain in this way more than a small fraction of the iodine present. Such is the activity of this wonderful element when in the free state in a large proportion of water, and in contact with anything capable of acting either as an oxidiser or a reducer, that it seems impossible to retain it for any time in its free state. Bromine, on the other hand, may very readily be distilled off sea-water; and if I had occasion to estimate this element in the water, I would begin by distilling it off, after adding a suitable reagent, rather than by the usual way of fractional precipitation, which latter process, owing to the solubility of bromide (as well as of iodide) of silver, in strong solution of chloride of sodium, can scarcely be expected to yield accurate results.

Were it not for the interfering action of other compounds, and particularly of ferric oxide, in sea-water, the iodine might be estimated very closely by simply setting it free and ascertaining its amount by any suitable process. In practice, only about half the iodine present can thus be estimated, since the ferric oxide present assists in the reaction..

It seems advisable, however, to pause here a moment, and consider how a quantitative estimation can be made of the iodine in a solution which at best gives a reaction only just distinctly recognisable to a trained eye. When carbonic disulphide is shaken up with a solution of iodine in pure water, the proportion of iodine taken up by the disulphide is such as to balance the affinities of the iodine between the water and the disulphide. If to the iodine solution a salt is added which increases the affinity of that solution for iodine, then a less proportion of iodine is taken up by the disulphide. The proportion of iodine abstracted from any solution by disulphide depends, firstly, upon the relative solubilities of iodine in the two liquids, and, secondly, upon the proportion of disulphide used to the quantity of liquid taken for experiment. That this is so may be easily seen by shaking up disulphide with any liquid (such as a strong solution of iodide of potassium containing free iodine) having an affinity for iodine approaching to that of carbonic disulphide. Hence it is that the iodine colour reaction is most delicate when the solubility of iodine in the solution acted upon is lessened in any way, as by cold. Sea-water can dissolve more iodine than pure water, and therefore starch or carbonic disulphide become less intensely coloured by a proportion of iodine set free in sea-water than by the some proportion set free in pure water. Nevertheless, the conditions being the same, the quantity of iodine actually in a free state in two instances being equal, the same proportion of any decolourising agent will be needed in both cases, although in the one the disulphide may be intensely coloured, and in the other only faintly tinged. It is, however, in the latter case, desirable to add the decolourising agent in such manner as to act upon the iodine retained by the liquid earlier than upon the iodine retained by the disulphide. It is therefore possible (and that it is so has been experimentally abundantly confirmed) to obtain quantitative results of nearly, or quite, equal accuracy when a given proportion of iodine in a liquid imparts a faint tinge only, as when it imparts a strong colouration to the disulphide used.

When sea-water is concentrated, even under conditions that effectually prevent any decomposition taking place of the iodate it contains, a soluble barium salt throws down less iodic acid than it does from the unconcentrated water. The loss arising from the increased solubility of the iodate of barium, owing to the accumulation of common salt in the liquid, exceeds any gain obtained by acting upon a less bulk of liquid. The same is true when hydriodic acid is formed from the iodic acid in sea-water, a silver salt added, and the liquid evaporated. Water, added to the dry residue in quantity sufficient to dissolve the chloride of sodium, takes up all the iodide of silver. If weak alcohol is used to dissolve out the chloride of sodium, and the whole filtered, only a trace of iodide of silver remains upon the filter. Indeed, iodide of silver is not quite insoluble in alcohol, although the alcoholic solution is not strong enough to be precipitable by water. If the residue is dissolved in hydrochloric acid, which must necessarily be used somewhat dilute, the result is much lower than when the unconcentrated water is used. But when sea-water, the iodate in which has been decomposed by addition of a solution of, say, arsenious anhydride in hydrochloric acid, and evaporated with addition of sulphate of copper, the residue dissolved in the least possible quantity of water, and the solution filtered, the iodine remains on the filter as cuprous iodide, and its amount may be estimated by gently igniting the filter with a little hydrate of sodium, taking up the iodide of sodium with water, filtering, and estimating the iodine in the filtrate, after acidulating with dilute *sulphuric* acid, by chlorine water and carbonic disulphide.

It might be perhaps imagined that to evaporate a liquid containing an iodide with hydrochloric acid would occasion loss of hydriodic acid or of iodine. Hydrochloric acid may be boiled for days together over iodide of silver without in the least degree decomposing that salt. Hydriodic acid, boiled with an alkaline chloride, will, if used in excess, expel nearly all the hydrochloric acid; but, when the solution gets very much concentrated, some iodine is separated and lost. Nevertheless, practically, chlorides may be converted into iodides by boiling with hydriodic acid in excess, and this probably because the boiling-point of hydriodic acid is higher than that of hydrochloric acid. Hence, the less soluble iodides may be evaporated to dryness with hydrochloric acid without much, if any, loss; and experience has not enabled me to detect any loss in such cases—so far, at least, as relates to the iodides of silver and of copper produced in sea-water as described. The only appreciable source of loss arises from the solvent action of the solution of chloride of sodium on the precipitates, which, in the case of cuprous iodide, appears to be very slight.

The five following quantitative experiments were consecutive, and are given in the order in which they were made; I mean that they are not picked out of a series, but taken as they came. The precipitates were all treated as has just been described. The chlorine water used was very dilute, and did not vary in strength by so much as 1 per cent daily; it was delivered out of a narrow-necked flask by a piece of quill tube drawn out at one end, and the quantity delivered ascertained by weighing the flask and its contents (including the tube) before and after each experiment. The chlorine water was standardised by testing with weighed portions of solution of pure iodide of potassium. Each experiment involved four weighings, except such as were made in quick succession, when it sufficed to ascertain the weight of the chlorine water used. By proceeding thus, all possibility of the results of the experiments being influenced by unconscious bias was prevented. 200 c.c. of water were taken for each experiment, except for (4), which had 400. For uniformity's sake, the results are given in each case for 100 c.c., and the iodine is stated as iodide of potassium.

(1).	100 c.c. sea-water	0·000229 KI.
(2).	,, ,,	0·000203 ,,
(3).	,, ,,	0·000236 ,,
(4).	,, ,,	0·000330 ,,
(5).	,, ,,	0·000277 ,,

(1). 200 c.c. of water evaporated, after addition of a c.c. or two of hydrochloric acid and a decigramme or two of hyposulphite of sodium, to about a fourth. Filtered off sulphur, and added to filtrate solution of a few milligrammes of sulphate of copper. Slightly supersaturated with NH_3, and filtered after an hour or two.

(2). 200 c.c. of water. Did not evaporate. Added c.c. or two of solution of arsenious anhydride in hydrochloric acid, then sulphate of copper as in (1). Rendered just alkaline by ammonia, and filtered after a while.

(3). 200 c.c. Solution AsO_3 in HCl added as in (2); also copper solution. Evaporated to dryness, and *dried strongly*. Took up with water and filtered.

(4). 400 c.c. As (3), but less strongly dried.

(5). 200 c.c. Added hydrochloric solution of arsenious anhydride, then about 50 c.c. of strong HCl acid, and acetate of silver until a slight permanent opalescence was produced. Filtered after some hours.

It will be observed that, in three out of these five experiments, the water was not concentrated.

The copper and silver processes may be thus compared:—

Copper Process.		*Silver Process.*	
Without concentration (2)	203	Without concentration (5)	277
With evaporation to dryness (4)	330	With evaporation to one-fourth (6)..	170

Experiment (6) was not consecutive with the other five experiments, and is introduced only to illustrate the relative value of the two processes. Thus it appears that the silver and hydrochloric acid process is rather better than the copper process when the water is not evaporated; and that the copper process is greatly superior to its rival when the water is concentrated, and still more so when a dry residue is obtained.

Experiment (4), which gave the highest result, is probably very near, and not over, the truth; for, in such experiments as these, loss arising from a partial solution of the precipitates is unavoidable. I take, therefore, 33-100ths of a milligramme of iodide of potassium as representing the iodine present in 100 c.c., or 102·7 grms., of sea-water. This gives just one part of iodate of calcium in 250,000 parts by weight of sea-water. A cubic mile of sea-water therefore contains about 17,000 tons of iodate of calcium, or 11,072 tons of iodine.

One hundred million parts of sea-water are here estimated to contain four hundred of iodate of calcium; this is a little over two atoms in units. It seems at least remarkable that most of the constituents of sea-water, so far as these are quantitatively known, approach to a definite integral numerical ratio when compared according to their atomic weights. A glance at Thorpe and Morton's paper "On the Composition of the Water of the Irish Sea," or, probably, at any other elaborate analyses of sea-water, will show that the proportion of the constituents to one another hints at such a law. Nor let this be too carelessly condemned as fanciful. If the crust of the earth (excluding from consideration such partly mechanical mixtures as the Neptunic rocks, which are also derived rocks) consists of a mixture of an indefinite number of minerals of definite chemical constitution, then the aggregate constituents must have to one another a relation referable to the atomic weight of each; and if the soluble constituents were dissolved out so as to fairly "sample" the whole, and the water acting as such solvent were not liable to the segregating influence of force derived from life, then we should necessarily find the proportions of the elements in sea-water exactly adjusted to this law of atomic weights. If this view should gain strength from further investigations, however, it would become necessary to re-consider the modern theory respecting the power of isomorphous substances to replace one another in a definitely constituted mineral, in indefinite or anomalous proportions. It seems very desirable, from this point of view, that quantitative determinations should be made of, for instance, the lithium, the phosphoric acid, the strontium and barium, the presence of which in sea-water may be so easily detected.

I trust I may be excused by my older chemical readers the liberty I take of adding, in concluding this note, some remarks respecting the use of nitrate of silver in the analysis of salts containing chlorine, bromine, and iodine. If the solutions used are *perfectly neutral*, iodine and bromine are not set free; but the *slightest* acidity of the solutions determines the speedy liberation of chlorine, which, as it comes, decomposes, first the iodide of silver, and, the proportions being suitable, also bromide of silver. In other words, iodine and bromine are liberated, and, so far as chlorine is formed to effect this liberation, they are lost to the result. If the analyses of the bromine in sea-water have been made in acid solutions by nitrate of silver, another source of loss, besides that pointed out in a preceding paragraph, has been imported into the analyses.

That chlorine decomposes iodide and bromide of silver, in whatever conditions these salts may be, is very well known. Yet nitrate of silver is directed to be used in such analyses, and I have not met with any warning respecting the necessity of working with perfectly neutral or alkaline solutions. There is no such objection to the use of acetate of silver, which is also in every way a more convenient reagent, and it is very stable.

PRELIMINARY NOTE ON OZONE.

By CHARLES THOMAS KINGZETT.

Houzeau found that the oxygen evolved by treating baric peroxide with hydric sulphate contained an agent possessing the properties of ozone—that is to say, it liberated iodine from potassic iodide, and was capable of oxidising ammonia. I am not *aware* of any experiments in the same direction upon oxygen derived from other sources.

Whilst experimenting upon ozone, I was desirous of ascertaining if oxygen from all sources possessed the properties ascribed to that obtained from baric peroxide and hydric sulphate; therefore I made the subject a matter of experiment, and obtained amongst my results the following:—

Oxygen obtained by either—

(*a*). Heating mercuric oxide, and passing the resulting gas through strong and pure potassic hydrate (to absorb any nitrous fumes);

(*b*). Acting upon potassic dichromate with hydric sulphate;

(*c*). Acting upon potassic permanganate with hydric sulphate; or,

(*d*). Heating *native* or *artificial* manganic dioxide;— liberated iodine from potassic iodide, forming, when starch was present, the blue iodide. In short, from every source I have tried, the oxygen produced never lacked these properties. Of course contact of the gas examined with organic matter was avoided as far as possible.

Thus in (*a*), the tube containing the mercuric peroxide was drawn out, and bent twice at right angles, and then passed into a tube holding the potassic hydrate, the column depth of which was in every experiment more than four inches. (*b*) and (*c*) are readily performed in open test-tubes, placing at the mouths of the tubes the paper soaked in the potassic iodide and starch mixture.

But acting upon potassic permanganate with hydric sulphate requires care for (as is well known) if the mixture be heated, vapours of permanganic acid are evolved and detonations occur. I purposely obtained these detonations twice by placing the tubes containing the mixture in a steam-bath. The contents of the tubes smelt strongly of ozone afterwards, just like the fishy odour obtained by the passage of electric sparks through moist air or oxygen; and on holding a piece of iodide paper over the mouths of the tubes, iodine was rapidly liberated.

In (*d*), the manganic dioxide may be heated to bright redness, and yet the vapours evolved contain, or in some way produce, the agent alluded to before. This is remarkable considering that ozone is destroyed instantaneously at 300° C., and slowly at much lower temperatures. However, at present, I have no proof to offer that it *is* ozone; the moisture on the iodide paper may share in the reactions which occur.

I have ventured these statements in the belief that the facts stated are not *generally*, if at *all*, known. If they are known, my experiments merely confirm them, and if they are not known and explained, I hope to be able to show by a series of experiments which I am now making not only the effects but also the causes.

St. Ann's, St. Helen's, Lancashire.
May 14, 1872.

ON IMPROVING THE QUALITY OF IRON BY MEANS OF MECHANICAL PUDDLING.*

By FREDERICK A. PAGET, C.E.

PERHAPS the most important truth which has been lately elicited touching mechanical puddling is its effect in improving the quality of the puddled bar. Mr. Danks has worked up almost every kind of American and British pig metal with excellent results as to quality. Mr. Adam Spencer has in his revolving furnace produced excellent iron from Middlesborough metal containing 2 per cent of phosphorus. As already noticed, experience with oscillating rabbles points to more or less improvement in the quality. Mr. Hutchinson, as we have seen, improved the quality of Cleveland iron with his revolving rabble. M. Dormoy has puddled with success some old cannon-balls the Turks left behind them at Temesvar, in Hungary, so white, and containing such a large quantity of arsenic as to be utterly intractable by the ordinary process; he has also operated at Zeltweg, in Styria, upon pig metal alloyed with copper and sulphur; upon the sulphurous pig metal of the Loire and that of the Moselle—the latter containing very large percentages of phosphorus. In every case perfectly tough iron and steel, often rolled into the most difficult special shapes, have been produced. It is clear to the eye of the mechanic that all these otherwise very differing apparatus are alike in one particular—that of more or less thoroughly stirring up the first broken, then molten, and lastly pasty, metal, together with the fettling on the bed. The infinite variety of chemical conditions formed by the different kinds of pig and fettling, under which these results have been obtained in England, the United States, in France, Styria, Hungary, and Austria, clearly debar us from searching for any recondite chemical cause; and it is evident that, whether this thorough stirring be obtained by exhausting manual labour, or by an imperfect oscillating rabble, or by a revolving bed, or by a revolving rabble, the mechanical effect must be the same. That is to say, the molten cast-iron has to be continuously stirred up in order, in the common furnace, to expose it to the oxygen entering at the door, and contained in the fettling; in Mr. Danks's and Mr. Spencer's furnaces to the oxygen in the latter only.

There thus seems to be three principal reasons why mechanical puddling, or, in other words, good puddling, produces such good iron. The operation is (1) completely carried out; (2) the puddled bar is really homogeneous; (3) the multiplication of the surfaces of contact intensifies the purifying chemical reactions.

1. Very good iron is of course often produced by hand puddling; but it is a labour clearly beyond human strength required to be continuously exerted—day by day, and night after night—for years. In hand puddling there is hence notoriously a liability in the "underhands" shirking their arduous work, and producing bad iron. Mr. Menelaus, of Dowlais, has, in fact, publicly stated that in hand puddling "it was often found that portions of badly-puddled iron have been wrapped up in the ball by the puddler." This statement may be said to have been long ago distinctly proved by a process that underwent a thorough trial. Mr. Davis, of the Low Furness Iron and Steel Works, proceeded in the belief that an ordinary puddled ball really consists of a mixture of good and completely converted iron with "raw," or only partially converted, iron. On crushing such balls, when cold, under stamps, and grinding the pieces between rolls, they separated themselves into two distinct sorts, namely, lumps of wrought-iron originally embedded in, so to say, husks of white pig-iron. By re-heating and working up the portions thus demonstrated to be wrought-iron, excellent blooms were produced; but the plan did not answer financially.

2. An assumption that the lumps of pig metal as usually charged into the puddling furnace could produce homogeneous iron without some stirring up could only be based on the supposition that they were all similar in chemical composition and specific gravity. When, for instance, copper and tin are melted together to form brass, unless they are stirred up while being fused and run out, the metals separate, and arrange themselves according to their densities; and this action in the case of pig metal would only take place in a somewhat less degree on account of the slighter divergences between the different portions. As a matter of fact, "fined" iron does tend to rise to the top.

3. Few facts connected with metallurgy are more certain than that, while the carbon and silicon are easily oxidised out of pig metal, this is not the case with phosphorus and sulphur, the first rendering the iron cold-short, and the second red-short. Mr. Parry considers "that the effect of puddling is to reduce the quantity of sulphur to about one-third, and of phosphorus from one-fourth to one-fifth of that originally contained in the pig-iron." Mr. I. Lowthian Bell is of opinion that nine-tenths of the phosphorus are expelled in puddling. It is only reasonable to conclude that this beneficial effect increases with good hand puddling, and rises in proportion with the thoroughness only obtainable by a steam-propelled rabble. The reactions between the metal and the fettling must be intensified by the increase of contact surfaces afforded. To take an instance. Black oxide of manganese was in 1835 advocated by Scharhäutl, and his recommendation has been confirmed by Caron's analyses, as an agent for taking up at least the sulphur. The difficulty attending it, however, consists in its not being fusible, and hence able to come into intimate contact with the iron. The powerful agitation afforded by the revolving rabble would, it is evident, just afford these large surfaces of contact. But without the use of more or less expensive "physic," it may be relied upon that inferior pig metal, thoroughly beaten up by this simple tool, will produce better iron, by at least 5s. per ton, than when the unaided and easily-fatigued human arm is employed.

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* From a paper "On the use of a Revolving Rabble in the Common Puddling Furnace."

THE PREPARATION OF CHRYSAMMIC ACID AND CHRYSAMMATES.

By WILLIAM A. TILDEN, D.Sc. Lond.

THESE beautiful compounds are usually prepared from aloes, but the soluble extractive matters which constitute at least half of the crude drug, yield little but picric and oxalic acids, and the resinoid gives a mere trifle of chrysammic acid.

I find it preferable, therefore, to employ for the manufacture of aloetic and chrysammic acids the aloin of Barbadoes aloes, which, since the discovery of Flückiger's "nataloin" would be appropriately named *barbaloin*. The following is an outline of the process I adopt. Fine Barbadoes aloes must be selected; and the variety which has a rich brown, not dark, colour and powerful odour, yields the best result. One part of such aloes is dissolved by agitation with seven or eight parts of boiling water, slightly acidulated with hydrochloric acid. The solution is allowed to cool and to remain at rest for twenty-four hours, when it may be strained to remove the deposited resin. It is then evaporated down in an open dish till a syrupy consistence is attained, and there remains rather less than two parts of liquid. This set aside for a day or two solidifies in consequence of the formation of a mass of granular crystals. The whole is drained in a calico bag, and then submitted to gradually increasing pressure till entirely free from the black mother-liquor. In this way a lemon-yellow mass of barbaloin results, which amounts to from 20 to 25 per cent of the aloes if a proper selection has been made. To render it quite pure, it requires one or two crystallisations from rectified spirit, but for the preparation of chrysammic acid this is unnecessary. It has only to be dried and powdered and introduced in small portions into about six times its weight of fuming nitric acid (sp. gr. 1·45), kept cool. After standing a few hours, about half its volume of water is added and heat applied until, in consequence of the formation of deposit, the liquid bumps. During this digestion a considerable quantity of carbonic anhydride escapes with the nitrous fumes. A further quantity of water is then added, and when cold the bright yellow crystalline deposit of aloetic and chrysammic acids filtered off. The liquid retains oxalic and picric acids, together with a small quantity of aloetic acid, which may be recovered by distilling away the nitric acid and washing the residue with water. The mixture of aloetic and chrysammic acids thus obtained is dried and boiled gently for eight or ten hours with sufficient nitric acid to cover it. Water is again added, and the crystalline precipitate collected and washed till the washings become pink. It is then boiled for an hour with about an equal weight of potassic acetate dissolved in fifty parts of water. The solution thus obtained deposits on standing a copious crystallisation of green sparkling potassic chrysammate, which may be washed with a little cold water. The mother-liquors, which retain potassic aloetate, are evaporated down, acidified by nitric acid, and the aloetic acid converted into chrysammic acid by further treatment with nitric acid, as already described.

Proceeding in this way, barbaloin readily yields more than a third of its weight of pure potassic chrysammate.

Chrysammic Acid.—Crystals of chrysammic acid are best obtained by dissolving potassic chrysammate in a considerable quantity of boiling water, and strongly acidifying the liquid with acetic acid. Thin yellow fern-leaves, a quarter of an inch long, mixed with a few long red crystals, are deposited in a few hours. On warming the whole gently, the latter are re-dissolved, and the yellow fern-leaves, which are mixed with a few much smaller tables, may be filtered off and washed. They consist of pure chrysammic acid; in mass they strongly resemble picric acid, but are more lustrous.

After exposure to dry air at ordinary temperatures for a few days, they suffer no loss of weight by heating to 150° C. Evaporated with pure sulphuric acid, they leave no residue.

Lead Chrysammate.—Described by Schunck and Mulder as a red powder containing variable proportions of lead. It may easily be obtained, however, beautifully crystallised, by mixing a boiling solution of potassic chrysammate with a slight excess of plumbic acetate dissolved in boiling-water and acidified with acetic acid. On cooling, long thin prisms, exhibiting a magnificent bronze reflection, are formed. The light transmitted by the crystals is pale red and strongly polarised, so that on viewing, by means of a lens, some of them suspended in the mother-liquor, the light is seen to be completely cut off when two of them cross each other at right angles. Mounted properly, they form a pretty microscopic object.

The salt was found to have the formula—

$$C_{14}H_2Pb''(NO_2)_4O_4.4H_2O.$$

	Theory.	Experiment.
Pb	29·69	28·92
H_2O	10·33	10·18

Barium Chrysammate.—Hitherto described as a red powder. Obtained in the crystalline form by mixing boiling solutions of potassic chrysammate and barium chloride acidified with acetic acid. It appears to be one of the most insoluble of the chrysammates, as the mother-liquors left after the crystallisation of the salt are almost colourless. It forms brown shining needles, which, however, present none of the green or golden lustre so noticeable in most of the other salts.

The formula seems to be the same as that assigned by Mulder to the uncrystallised compound, viz.:—

$$C_{14}H_2Ba''(NO_2)_4O_42H_2O.$$

	Theory.	Experiment.
Ba	23·18	22·77

Potassium Chrysammate crystallises in two forms—usually as dark red spangles with bright green lustre, or when the salt is crystallised quickly, or from a slightly acid solution, as bright crimson needles with slight golden reflection. The red crystals have the formula—

$$C_{14}H_2K_2(NO_2)_4O_4·3H_2O.$$

	Theory.	Experiment.
H_2O	9·81	9·09

The formulæ used in this paper are double those hitherto employed for chrysammic acid and its compounds, and are in accordance with the view of Græbe and Liebermann, who represent chrysammic acid as a derivative of anthrachinon. On this supposition it must be a dibasic acid, and I have therefore made some attempts to prepare some salts, the constitution of which might help to decide this question. At present, however, I have not been successful in producing acid or double salts presenting characters such as would entitle them to be pronounced definite compounds.—*Pharmaceutical Journal.*

THE HENDERSON PROCESS

FOR THE

REMOVAL OF PHOSPHORUS FROM IRON.

LAST week, in referring to experimental trials of this process, we stated that iron had been made in the presence of a committee of scientific men, and tested at Mr. David Kirkaldy's works. Through the courtesy of the inventor of the process we are now able to publish Mr. Kirkaldy's certificate of the tests, which will, we are sure, excite great interest.

Results of Experiments to ascertain the Elastic and Ultimate Tensile Strength, &c., of One Piece of Billet-Bar and One Piece of Plate received from Millwall Iron Works.

Test No.	Description.	Stress.		Ratio of Elastic to Ultimate.	Contraction of Area at Fracture.	Stress per sq. inch of Fractured Area.	Extension in 5 ins.		Appearance of Fracture.
		Elastic, per square inch.	Ultimate, per square inch.				At 40,000 lbs. per sq. in.	Ultimate.	
G.		lbs.	lbs.	per cent.	per cent.	lbs.	per cent.	per cent.	
1634	Bar, as rolled	23,400	56,735	41·2	37·8	91,213	3·60	29·4	Fibrous.
1635	Bar, heated and cooled in water	39,300	76,980	51·1	6·7	82,508	0·22	6·2	95 per cent, crystalline, fine.
*1636	Plate, as rolled	29,800	54,788	54·4	21·7	69,985	2·04	12·2	Fibrous.
*1637	,, ,, ...	28,900	53,196	54·3	18·7	65,405	3·76	15·6	Ditto, irregular.

* No. 1636 cut off at right angles to 1637.

"I hereby certify that the above bar and plate were made at the Millwall Iron Works (Messrs. Joshua Jeavons and Co.) on the 7th of May, 1872, by the Henderson process, and witnessed by several gentlemen. That the charge consisted of 448 lbs. of grey Cleveland pig-iron, brand 'Clarence,' 152 lbs. of ilmenite, and 56 lbs. of fluor spar. Two balls were formed by puddler, shingled under steam-hammer, heated in furnace, and then rolled, one of the balls into a billet-bar $1\frac{7}{8}'' \times 1\frac{7}{8}''$, the other into a plate $\frac{5}{16}''$ thick, and that both were stamped with my die for subsequent identification.

"I also witnessed a second charge, consisting of 448 lbs. of the same pig-iron ('Clarence'), 56 lbs. of fluor spar, and 56 lbs. of burnt brick, formed into three balls, and shingled; but, owing to some misunderstanding, were not heated in time for rolling before I left the works at 9.40 p.m.

"To James Henderson, Esq., of New York, Tavistock Hotel, Covent Garden, W.C.

"David Kirkaldy.

"The Grove, Southwark Street, London, S.E.,
"May 21, 1872."

NEW RESEARCHES ON THE PHOSPHORUS BASES.*

By A. W. HOFMANN, LL.D., F.R.S.,
Professor of Chemistry in the University of Berlin.

(Continued from p. 235.)

III. *Products of Oxidation of the Phosphines of the Methyl Series.*

When determining phosphorus in several substances which, in the course of the new researches on the phosphines, had to be examined, it was found that these bodies, and especially the members of the methyl series, resist with remarkable energy the action of oxidising agents.

If the bodies were heated according to Carius's method, it happened sometimes, when the digestion in sealed tubes was conducted according to the earlier directions with a nitric acid not perfectly concentrated and at moderate temperatures, that the liquid taken from the tube and treated in an appropriate manner with magnesian salts gave no precipitate whatever. If, on the other hand, strongest fuming nitric acid be employed at very high temperatures, phosphoric acid is certainly formed; but only when the reaction takes place at the very extreme temperatures recommended by Carius† in his more recent paper is the whole quantity of phosphorus made precipitable by magnesium salt.

It appeared of interest to submit to a closer examination the products of oxidation that are formed by the action at moderate temperatures of nitric acid on the primary and secondary phosphines, some of which have probably passed already through the hands of M. Paul Thenard when engaged in his remarkable, but unfortunately unfinished, researches on this subject. Experiment showed that under these circumstances new acids of great stability and comparatively little volatility are formed, and a very simple method of estimating phosphorus in this whole group of compounds at once suggested itself. It was only necessary to dissolve the substance under examination, according to circumstances, either in strong hydrochloric or nitric acids, to mix the liquid slowly with fuming nitric acid, to treat the solution after evaporation with excess of sodium carbonate, and finally to dry and fuse the mass in a porcelain crucible; in this way the oxidation of the phosphorus is easily and perfectly accomplished. All the phosphorus estimations necessary in these researches have been performed in this manner.

Experiments in the Methyl Series.

Monomethylphosphinic Acid.—In order to obtain the product of oxidation of methylphosphine in appropriate quantity, a slow stream of the gas was directed into fuming nitric acid; it would have been unnecessary in this case to employ the phosphine gas in a state of purity. It was sufficient to make use of the methylphosphine as it is delivered from the crude product of the action of methyliodide on phosphorus iodide and zinc oxide by treatment with water. This gas always contains small quantities of phosphuretted hydrogen, which ignite on contact with the fuming acid and easily give rise to small explosions. As the methylphosphine becomes purer these become more seldom, and at last quite cease. Invariably, however, in consequence of these detonations, more or less phosphoric acid is formed amongst the products of oxidation.

To get rid of the nitric acid, the solution is several times evaporated to dryness on a water-bath, the residue dissolved in water, and the liquid boiled with lead oxide for the purpose of separating the phosphoric acid; a lead-salt is thus formed which is insoluble in water, but dissolves in acetic acid, leaving an appreciable residue of lead phosphate. This solution is freed from lead by means of sulphuretted hydrogen, and from acetic acid by repeatedly evaporating, when the new body remains as an oily liquid, which, on cooling, solidifies into a crystalline mass resembling spermaceti. The crystals thus produced, which could not be obtained in distinct forms, are hygroscopic, but not deliquescent. They readily dissolve in water, the solution restoring litmus red to blue, and possessing, moreover, an agreeable sour taste. They are also soluble in alcohol, less so in ether; the alcoholic solution, however, is not precipitated by ether. The stability of this body is quite remarkable; that it is not altered by fuming nitric acid is evident from the manner of its preparation; but even by repeated evaporation with *aqua regia* not the slightest change is produced.

The new compound melts at 105° C.; it is volatilised, at least for the greatest part, without decomposition; when strongly heated it evolves an inflammable gas, a small residue of phosphoric acid mixed with more or less carbon remaining behind.

Analysis showed that methylphosphine, by treatment with nitric acid, fixes three atoms of oxygen, the com-

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* A paper read before the Royal Society.
† *D. Chem. Ges. Ber.*, 1870, p. 697.

position of the new body being represented by the formula $CH_5PO_3 = (CH_3)H_2PO_3$.

The new substance is a well-marked acid; I will designate it by the name placed at the head of the paragraph, *i.e.*, *monomethylphosphinic acid*, or, more briefly, *methylphosphinic acid*. It forms two series of salts, the construction of which is represented by the formulæ—

$$(CH_3)HMPO_3 \text{ and } (CH_3)M_2PO_3.$$

The primary (acid) salts are produced by the reaction of the metallic carbonates, or by incomplete saturation with the free bases. For the preparation of the secondary (neutral) salts, the acid must be completely saturated by the free bases. They can, however, also be obtained by means of the carbonates, if the latter, as is the case with the alkaline carbonates, are capable of fixing the carbonic acid which is liberated.

The primary methylphosphinates have an acid, the secondary salts an alkaline, reaction; these latter are soluble, and only little inclined to crystallise. The ammonium salts lose ammonia by evaporation, leaving the acid behind. Amongst the metallic salts, especially the primary ones, many are insoluble, or soluble only with difficulty.

Silver MethylPhosphinate.—If the acid be saturated with silver oxide, and the solution evaporated to the consistence of a syrup, the primary salt separates from the solution in beautiful white needles, which, however, in contact with water, and even with alcohol, are readily converted into the secondary salt with separation of the free acid.

The salts obtained by means of silver oxide, and purified by washing with water, gave numbers which showed that it consisted of a nearly pure secondary compound. In order to obtain this salt quite pure, the solution of the acid was accurately neutralised by ammonia and precipitated by silver nitrate. It is a white amorphous precipitate, nearly insoluble in water, having the composition $CH_3Ag_2PO_3$.

Lead Methylphosphinate.—If an aqueous solution of methylphosphinic acid be boiled with an insufficient quantity of lead oxide, the primary and secondary salts are formed at the same time, the latter as a white amorphous heavy powder which collects at the bottom of the hot liquid, the former crystallising from the liquid as it cools in beautiful, long, lustrous, white needles. On washing with water, the salt is decomposed like the silver compound, gradually forming the secondary salt and free acid. Indeed, analysis of the washed crystals gave numbers lying between those required for the primary and secondary salts. The secondary salt may be obtained, however, in a state of purity if the barium salt presently to be described be decomposed by lead acetate. It is a precipitate almost insoluble in water, but soluble in acetic acid. Its composition is $(CH_3)PbPO_3$, or perhaps more correctly $(CH_3)_2PbP_2O_6$.

Barium Methylphosphinate.—This is obtained by boiling the acid with barium carbonate, evaporating the solution to the consistence of a syrup, and precipitating by alcohol. It is a white powder, consisting of microscopic needles easily soluble in water. The aqueous solution, even on slow evaporation, yields no crystals, but dries to a gummy mass. Analysis showed the salt to be the primary compound $C_2H_6BaP_2O_6 = (CH_3)_2H_2BaP_2O_6$.

Methylphosphinic acid has the same composition as methylphosphorous acid, but it is only necessary to compare the above statements with what is known respecting the latter compound in order to see that they constitute two absolutely different bodies. Methylphosphorous acid is an uncrystallisable ephemeral compound, decomposing even at a gentle heat into phosphorous acid and methyl alcohol, and cannot possibly be mistaken for the extremely stable derivative of methylphosphine, which may even be distilled without undergoing any decomposition.

Dimethylphosphinic Acid.—By this name I designate an acid which is produced by the action of nitric acid on the secondary methyl base. In preparing this body it is convenient to start from the chlorhydrate of dimethylphosphine. A solution of this salt is readily obtained when the crude product of the action of phosphonium iodide on methyliodide after the expulsion of methylphosphine by water is distilled with alkali, and the dimethylphosphine thus disengaged is passed into hydrochloric acid. If this solution be mixed with fuming nitric acid, a powerful reaction ensues, heating the liquid to ebullition, and fumes of nitrous acid are copiously evolved. In order to free the strongly acid solution from nitric acid, it is repeatedly evaporated with hydrochloric acid, and then heated for some time on the water-bath to expel as far as possible also this latter body. To get rid of the last traces of hydrochloric acid, the liquid is saturated with silver oxide and the solution filtered from the silver chloride, precipitated by sulphuretted hydrogen. The solution again evaporated on the water-bath gradually solidifies to a white paraffin-like mass of crystals, which, on contact with the air, are apt to become slightly brown. They are very soluble in water, alcohol, and ether; these solutions have a decidedly acid reaction. The crystals melt at 76°; at a higher temperature they are volatilised without decomposition; indeed, the distilled product shows the same melting-point as the undistilled acid. Dimethylphosphinic acid is less soluble for analysis than the mono compound. It appeared sufficient to fix its composition by the examination of the silver-salt. This analysis proved that the acid is represented by the formula $C_2H_7PO_2 = (CH_3)_2HPO_2$. It is thus seen that dimethylphosphine, when treated with nitric acid, fixes not three atoms of oxygen, like the monomethylated base, but only two. Dimethylphosphinic acid forms only one series of salts having for the general formula $C_2H_6MPO_2 = (CH_3)_2MPO_2$.

Silver Dimethylphosphinate.—This salt is obtained by saturating the crude acid still retaining hydrochloric acid with silver oxide, evaporating the filtered solution, and precipitating the concentrated liquid with absolute alcohol. The salt presents itself in the form of fine felty white needles extremely soluble in water, but very slightly so in ether and absolute alcohol. Its composition is represented by the formula $C_2H_6AgPO_2 = (CH_3)_2AgPO_2$.

Barium Dimethylphosphinate.—By boiling the solution of the pure acid with an excess of precipitated barium carbonate, a neutral liquid is obtained, which, when evaporated on the water-bath, dries up to a transparent varnish. On contact with a hard body this clear varnish becomes opaque, and shows inclination to crystallise. It is soluble also in alcohol.

Lead Dimethylphosphinate.—The preparation is conducted in the same manner as that of the barium salt, only that oxide instead of carbonate is employed. In its properties it resembles the barium salt; the varnish dissolves in a small quantity of water; the solution becomes turbid, however, by the addition of a larger quantity. Several lead determinations showed excess of lead above that contained in the normal dimethylphosphinate, which cannot surprise when considering the tendency of lead to form basic salts and the absence of all properties warranting the purity of the compound.

It is of some interest to compare the behaviour of phosphuretted hydrogen under the influence of powerful oxidising agents with that of its several methylated substitution-products. Phosphuretted hydrogen, on treatment with concentrated nitric acid, fixes four atoms of oxygen, becoming converted into TRIBASIC orthophosphoric acid; methylphosphine similarly treated combines with only three atoms of oxygen, forming DIBASIC methylphosphinic acid, under the same conditions. Dimethylphosphine appropriates not more than two atoms, giving rise to *monobasic* dimethylphosphinic acid. Lastly, trimethylphosphine fixes but one atom of oxygen, the products of the reaction being trimethylphosphide oxide, observed some years ago by Cahours and myself; this body is *no longer capable of forming saline compounds.* We thus arrive at the following series:—

$$\begin{aligned} H_3P+O_4 &= H_3PO_4. \\ (CH_3)H_2P+O_3 &= (CH_3)H_2PO_3. \\ (CH_3)_2HP+O_2 &= (CH_3)_2HPO_2. \\ (CH_3)_3\ P+O &= (CH_3)_3\ PO. \end{aligned}$$

On examining this series it is observed at once that all the bodies here described are derived from phosphoric acid. The acids generalised from the methylated phosphines being phosphoric acid, the hydroxylic groups of which are successively replaced by methyl.

Orthophosphoric acid .. .. $\left.\begin{matrix}HO\\HO\\HO\end{matrix}\right\}PO.$

Methylphosphinic acid .. $\left.\begin{matrix}CH_3\\HO\\HO\end{matrix}\right\}PO.$

Dimethylphosphinic acid .. $\left.\begin{matrix}CH_3\\CH_3\\HO\end{matrix}\right\}PO.$

Trimethylphosphine oxide .. $\left.\begin{matrix}CH_3\\CH_3\\CH_3\end{matrix}\right\}PO.$

This symmetrically constituted series does not stand alone. Indeed, orthoarsenic acid forms the starting-point of a perfectly analogous group of compounds, which are obtained, however, by processes different from those which yield the phosphorous bodies. The substances corresponding to methylphosphinic acid is arsenomonomethylic acid, discovered by M. Baeyer; that analogous to dimethylphosphinic acid, the well-known kakodylic acid of M. Bunsen; finally, trimethylarsine oxide has been obtained by M. Cahours when submitting trimethylarsine to the action of oxidising agents.

Orthoarsenic acid .. .. $\left.\begin{matrix}HO\\HO\\HO\end{matrix}\right\}AsO.$

Arsenmonomethylic acid .. (Methylarsenic acid) $\left.\begin{matrix}CH_3\\HO\\HO\end{matrix}\right\}AsO.$

Kakodylic acid .. .. (Dimethylarsenic acid) .. $\left.\begin{matrix}CH_3\\CH_3\\HO\end{matrix}\right\}AsO.$

Trimethylarsine oxide .. $\left.\begin{matrix}CH_3\\CH_3\\CH_3\end{matrix}\right\}AsO.$

The formation of methyl- and dimethylphosphinic acids is thus seen to illustrate again the unmistakeable analogy of the two elements, phosphorus and arsenic, already traced in so many directions. I hope that the continuation of these researches will still further elucidate this similarity. There can be no doubt that the several members of the kakodyl series from which arsenomonomethylic and kakodylic acids have been produced will soon be represented amongst the derivatives of phosphorus. The discovery, too, of the primary and secondary arsines, the oxidation of which, as is obvious from the results described in this note, must yield the same acids, will probably not have long to be waited for.

(To be continued).

ON THE LAST NEW METAL, INDIUM.*

By WILLIAM ODLING, M.B., F.R.S.
Fullerian Professor of Chemistry, R.I.

The word "element" is used by chemists in a peculiar and very limited sense. In calling certain bodies elements, there is no intention on the part of chemists to assert the undecomposable nature or essence of the bodies so called. There is not even an intention on their part to assert that these bodies may not suffer decomposition in certain of the processes to which they are occasionally subjected; but only to assert that they have not hitherto been proved to suffer decomposition; or, in other words, to assert that their observed behaviour under all the different modes of treatment to which they have been exposed, is consistent with the hypothesis of their not having undergone decomposition.

The entire matter of the earth then, so far as chemists are yet acquainted with it, is composed of some sixty-three different sorts of matter that are spoken of as elementary; not because they are conceived to be in their essence primitive or elementary, but because, neither in the course of nature nor in the processes of art, have they been observed to suffer decomposition. No one of them has ever been observed to suffer the loss of any substance different from the substance of its entirety, so as to leave a residuary substance different from the substance of its entirety. Thus chemists are incapable of taking away from iron, for example, a something that is not iron; or of taking away from it anything whatever, so as to leave a residue that is not iron; whereas they are capable of taking away from iron pyrites a something which is not iron pyrites but is sulphur, so as to leave a residue which is not iron pyrites but is metallic iron.

The notion of all other material bodies being constituted of, and decomposable into, a limited number of elementary bodies, which could not themselves be proved to suffer decomposition or mutual transformation under any circumstances whatever, but could, on the contrary, be traced respectively through entire series of combinations, and be extracted at will from each member of the series, is a notion which, undergoing in course of time a gradual development, was first put forward in a definite form by Lavoisier; until whose time, some residue of the great alchemical doctrine of the essential transmutability of all things—that the substance of all things was the same, while the form above was different—still prevailed. To Lavoisier is due the enunciation of the principle,—departed from, however, in a few instances by himself,—that all bodies which cannot be proved to be compounded, are in practical effect, if not in absolute fact, elementary, and are to be dealt with accordingly.

Of the many definite substances known to chemists before the discovery of hydrogen gas, the following were afterwards recognised by Lavoisier and his colleagues as elementary. First, the seven metals known to the ancients, namely, gold, silver, mercury, copper, iron, tin, and lead, distinguished respectively by the signs of the sun, moon, and planets; and each conceived to have some mystic connection with the particular orb or planet of which it bore the sign, and not unfrequently the name. Then three metals which became known at the latter end of the fifteenth or beginning of the sixteenth century, namely, antimony, discovered by Basil Valentine in 1490; bismuth, mentioned by Agricola, 1530; and zinc, mentioned by Paracelsus, ob. 1541. An elementary character was also assigned to the non-metals carbon and sulphur, which had been known from the earliest times; to phosphorus, discovered by Brandt, of Hamburg, in 1669; and to boracic acid, now known to be a hydrated oxide of boron, first discovered by Homberg in 1702, and still occasionally spoken of as Homberg's sedative salt. The list was further swelled by four metals which, in Lavoisier's time, had been but recently discovered, namely, cobalt and arsenic, identified simultaneously in 1733 by George Brandt, of Stockholm; platinum, discovered in 1741 by Woods, assay-master at Jamaica; and nickel, discovered in 1751 by Cronstedt.

The only other bodies known before 1766, and afterwards included in the class of elements, namely, the alkalies and earths, had during the quarter of a century immediately preceding been made the subjects of especial study. The differentiation of potash from soda, both previously known by the common name of alkali, was indicated by Duhamel in 1736, and more completely established by Marggraf in 1758. The differentiation from one another of lime or calcareous earth, silex or vitrefiable

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* Read before the Royal Institution of Great Britain.

earth, alumina or argillaceous earth, and magnesia or bitter earth, was accomplished by the labour of many chemists, more particularly Marggraf, Bergmann, and Scheele; prior to whose researches silex, alumina, and magnesia, together with their different combinations and commixtures with each other and with lime, were held to be but impure varieties of lime. The nature of the difference between the caustic alkalies and earths and their respective carbonates was made known by Black in 1756; while the real constitution of the alkalies and earths, as metallic oxides, though suspected by Lavoisier, was not established until the beginning of the present century, by Davy and his contemporaries and followers.

TABLE I.—ELEMENTS, &c., IN ORDER OF DISCOVERY.

—	Gold	☉
—	Silver	☽
—	Mercury ..	☿
—	Copper ..	♀
—	Iron	♂
—	Tin	♃
—	Lead	♄
1490	Antimony ..	B. Valentine.
1530	Bismuth ..	Agricola?
1541	Zinc	Paracelsus?
—	Carbon ..	
—	Sulphur ..	
1669	Phosphorus .	Brandt.
1702	Borax -on ..	Homberg.
1733	Arsenic ..	G. Brandt.
1733	Cobalt	
1741	Platinum ..	Woods.
1751	Nickel	Cronstedt.
1736 to 1758	Soda -ium ..	Duhamel.
	Potash	Marggraf.
	Lime	
	Silex	Bergmann & Scheele.
	Alumina ..	
	Magnesia ..	
1766	Hydrogen ..	Cavendish.
1771	Fluor -ine ..	Scheele.
1772	Nitrogen ..	Rutherford.
1774	Chlorine ..	Scheele.
1774	Oxygen ..	Priestley.
1774	Manganese .	Gahn.
1774	Baryta -ium .	Scheele.
1778	Molybdenum	
1781	Tungsten ..	Delhuart.
1782	Tellurium ..	Müller.
1789	Uranium ..	Klaproth.
1789	Zirconia -ium	
1791	Titanium ..	Gregor.
1793	Strontia -ium	Hope.
1794	Yttria -ium ..	Gadolin.
1797	Chromium ..	Vauquelin.
1798	Glucina -um .	
1802	Tantalum ..	Hatchett.
1803	Cerium ..	Klaproth.
1803	Palladium ..	Wollaston.
1803	Rhodium ..	
1803	Iridium ..	Descotils & Smithson Tennant.
1803	Osmium ..	
1811	Iodine	Courtois.
1817	Lithium ..	Arfwedson.
1817	Selenium ..	Berzelius.
1818	Cadmium ..	Stromeyer.
1826	Bromine ..	Balard.
1828	Thorinum ..	Berzelius.
1830	Vanadium ..	Sefstrom.
1839	Lanthanum .	Mosander.
1841	Didymium ..	
1843	Erbium ..	
1844	Ruthenium ..	Claus.
1846	Niobium ..	H. Rose.
1859	Cæsium ..	Bunsen.
1859	Rubidium ..	
1861	Thallium ..	Crookes.
1863	Indium ..	Reich & Richter.

The successive recognition of the elementary gases quickly following Black's remarkable discovery of carbonic acid gas, began by the identification of hydrogen by Cavendish in 1766. This was succeeded by the discovery of nitrogen by Rutherford in 1772; of chlorine and fluoric acid, the latter now held to be a fluoride of hydrogen, by Scheele in 1774; and of oxygen by Priestley in the same year.

Thus prior to the discovery of the first of the elementary gases, twenty-three kinds of solid matter, and one liquid body, mercury, were known, which afterwards became recognised as elements. Between then and the present time, thirty-three kinds of solid matter, and one liquid body, bromine, have been added to the list—the discovery of the earliest of them occurring almost simultaneously with, or even just preceding, that of the last discovered of the elementary gases.

Among the number of bodies discovered prior to 1803, when Davy effected the decomposition of the alkalies, several, at first thought to be elementary, are now known to be compounds of oxygen with other bodies still regarded as elements; and conversely, two bodies, namely, chlorine and fluorine, at one time thought to be oxides, have since become regarded as elementary; but in none of these cases did the discovery of what is now considered to be the real constitution of the bodies add or subtract an element to or from the list.

From the period of the modern or Lavoisierian conception of elements and compounds down to the beginning of the nineteenth century, the recognition of new elements occurred with much frequency, at short but varied intervals. After then, the discoveries became somewhat less frequent; but even within the last fifty years, no fewer than twelve new elements have been added to the list, being at the rate of one new element every four years. Throughout, the periods of discovery have been somewhat irregular in their occurrence. Thus in the years 1802 and 1803, six new elements were discovered, namely, tantalum, cerium, palladium, rhodium, iridium, and osmium; within the succeeding fourteen years only one new element, but that a very important one, namely, iodine; and in the fifteenth and sixteenth years, three new elements, namely, lithium, selenium, and cadmium. The longest barren interval, one of thirteen years' duration, took place between the discovery of niobium, by Rose, in 1846, and that of cæsium and rubidium, by Bunsen, in 1859. The last discovered of the elements, namely indium, being fully seven years old, and there being no reason to consider our present list as anything like complete, or to apprehend any cessation of additions thereto, it is now quite time for some other new element to be made known. For we may reasonably anticipate the discovery of new elements to take place at irregular intervals, possibly for centuries to come, and our list of the elements to be increased at least as much in the future as in the past.

The fresh discovery, however, of any abundant elementary constituent of the earth's crust would seem scarcely now to be expected, seeing that of the thirty-two elements which have become known since the year 1774—the year of the discovery of chlorine and oxygen and manganese and baryta—the great majority belong to the class of chemical curiosities; while even the four or five most abundant of the since discovered elements are found to enjoy but a sparing although wide distribution in nature, as is the case, for example, with bromine and iodine; or else to be concentrated but in a few specially localised minerals, as is the case, for example, with strontium and chromium, and tungsten. Of course it is difficult to appraise the relative abundance in nature of different elements; more especially from the circumstance of those which are put to commercial uses being everywhere sought for, and those not put to commercial uses being habitually neglected—save indeed by the man of science, to whom the peculiar properties of some of the less familiarly known elements, as palladium, osmium, erbium, didymium, uranium, and thallium, render them objects of the highest interest.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 16th, 1872.

Dr. Debus, F.R.S., Vice-President, in the Chair.

After the minutes of the previous meeting had been read, Messrs. J. Robins and A. J. Dickinson were formally admitted members of the Society.

The donations to the Society having been announced, the following names were read for the first time:—Messrs. John Emilius Shadwell, M.A., Walter Weldon, Walter Stewart, jun., John Ferguson, M.A., Charles Armbruster, George J. Snelus, and R. Wormell, M.A., B.Sc.

For the third time—Messrs. C. H. W. Biggs, John Grove Johnson, Joseph Arderne Ormered, B.A., and Ernest Henry Jacob, B.A., who were then ballotted for and duly elected.

Mr. H. T. Brown then read a paper "*On the Influence of Pressure upon Fermentation, Part I.*" In this investigation the author found that during the alcoholic fermentation of grape juice or malt wort, besides carbonic anhydride, that nitrogen, hydrogen, a hydrocarbon of the paraffin group, and sometimes nitric oxide, are evolved; moreover, the proportion of the gases unabsorbed by potassium hydrate is largely increased when the operation is carried on under diminished pressure. At the ordinary pressure, by far the larger proportion of these gases is nitrogen (70 to 90 per cent), but under diminished pressure, 400 to 450 m.m., the hydrogen preponderates (60 to 90 per cent). Nitrogen, however, does not occur when the solutions contain no albumenoids, even if ammonium salts are present in considerable quantity. The increase of the proportion of hydrogen, resulting from diminution of the pressure, is accompanied by formation of a comparatively large amount of acetic acid and aldehyde, so that it would seem that water is decomposed during the alcoholic fermentation, and that this result is facilitated by the diminution of the pressure. The presence of nitric oxide in the evolved gases was found to be due to the reduction of nitrates originally present in the solutions.

Dr. Debus said he had listened with great interest to the author's excellent paper on fermentation: it was a subject which had attracted the attention of chemists from a very early period.

Dr. Williamson expressed the cordial pleasure he had experienced in hearing Mr. Brown's account of the excellent and accurate experiments he had made. From the exceedingly novel and remarkable results obtained under diminished pressure, he was sure that those who, like himself, took an interest in the subject of fermentation, would look forward with pleasure to a further extension of these experiments.

Mr. Vernon Harcourt said there was one point particularly worthy of notice in these observations—namely, the alteration produced by the change in pressure Operating, as we ordinarily do, at the atmospheric pressure, which varies comparatively little, we do not take sufficient account of the altered circumstances produced by change of pressure. An instance of this had come under his notice in endeavouring to prepare pure ammonium nitrite: at the ordinary pressure, its aqueous solution is quite stable, but on attempting to evaporate it *in vacuo* over sulphuric acid, he found the diminished pressure produced an effervescence, decomposition ensued, and nitrogen was evolved.

Mr. Brown then read a preliminary notice "*On the Electrolysis of Sugar Solutions.*" A solution of glucose, when subjected to the action of the electric current, gives off, besides hydrogen and oxygen, a considerable quantity of carbonic acid and some carbonic oxide; the solution was then found to contain aldehyde, much acetic acid, and a little formic acid. Although not yet experimentally proved, the author believed that alcohol was formed during the electrolysis.

Dr. Debus, in thanking the author in the name of the Society, remarked that it would be very interesting if it should one day be found that alcohol could be produced from sugar without fermentation.

A paper "*On the Determination of the Solubility and Specific Gravity of Certain Salts of Sodium and Potassium,*" by D. Page, M.B., and A. D. Keightley, was then read for the authors by Mr. Hartley. The authors have carefully determined the solubility and density of saturated solutions of sodium and potassium nitrates and chlorides at a temperature of 15·6° C. The specific gravity of each of these salts at the same temperature was also accurately ascertained; and lastly, the specific gravity and degree of solubility of these salts in presence of each other was determined.

Mr. Atkinson then read "*An Examination of a Recent Attack upon the Atomic Theory,*" having reference to a paper by Dr. Wright "On the Relations between the Atomic Hypothesis and the Condensed Symbolic Expressions of Chemical Facts and Changes known as Dissected (Structural) Formulæ," recently read before the Society, and published in the April number of the *Phil. Mag.* The speaker said that Dr. Wright, notwithstanding his having asserted that the atomic theory is unnecessary, invariably uses it, arguing that we must either accept the atomic theory in order to revise the approximate results obtained in any given analyses, or adopt the actual number obtained, instancing Roscoe's analyses and determination of the vapour density of tungsten oxychloride and other tungsten compounds. Dr. Wright refers to the law of multiple proportions as one of the facts of chemistry; but experiment does not lead to numbers which are multiples of his combining numbers—that is, the law of multiple proportions is not an experimental fact. Thus, the vapour density of ferric chloride would lead to the atomic weight 112 for iron and that of aluminium chloride to 55 for aluminium. Dr. Wright's analysis of hydrobromate of bromocodide would lead him to the formula $C_{18\frac{1}{7}}H_{22\frac{1}{6}}Br_{1\frac{15}{16}}NO_2$, instead of $C_{18}H_{21}Br_2NO_2$, the one he had adopted; instead, however, of accepting the numbers obtained by analysis, he rejects them, and takes the nearest numbers which yield a formula containing only integral multiples of atomic weights. He also said that Dr. Wright had not attempted to explain the cause of isomerism, which can be readily done by the notion of the existence of atoms associated in different relative positions.

Dr. Wright said it was somewhat difficult to reply to a large number of objections which one had only just heard for the first time. He was afraid Mr. Atkinson had failed to understand the object of his paper, which was to distinguish between the employment of certain symbols to express certain facts, and the adoption of the atomic hypothesis to explain these facts. One of the charges was that of denying the atomic theory, and yet of employing that theory, the instance adduced being, that the approximate results obtained by his analysis of hydrobromate of bromocodide would lead to the formula $C_{18\frac{1}{7}}H_{22\frac{1}{6}}Br_{1\frac{15}{16}}NO_2$. He need only say that, taking into account the errors of experiment, such as the presence of water, &c., the nearest whole numbers which represent his results lead to the formula $C_{18}H_{21}Br_2NO_2$, and that, in assigning this as the formula, he did so quite independently of the atomic theory. With regard to his observations that the determination of the vapour density of ferric chloride and aluminium chloride would lead to he numbers Fe=112 and Al=55, the author seemed to have forgotten that the speaker had especially stated that compounds that dissociate, or are believed to do so, must be excluded in the determination of the combining number of the element. It is quite possible to express symbolically the difference between isomeric compounds without reference to any theory whatever; the two isomeric propylic alcohols, for instance, when treated with reagents, give rise to different products, and these facts can be recalled by the employment of symbols apart from all theoretical considerations. The speaker could scarcely see what great advantage was gained by the discussion of such a purely theoretical question as the constitution of matter, the important point being to express symbolically the facts with which we are acquainted. At present, sufficient distinction was not made between Dalton's proposal to represent the results of his quantitative analyses by symbols, and the theory founded on these results, namely, that matter is built up of small particles or atoms, and these again are united to form molecules. The latter was a subject which admitted of much discussion. The use of symbols to represent facts quite apart from any theory, gave us a power similar to that which the symbols in algebra gives to the mathematician.

Mr. J. **Newlands** observed that there was one part of Dalton's atomic theory which did not appear to be absolutely necessary to explain existing facts. Taking the simplest possible case, that of sodic chloride, and granting that this substance consists of molecules, each containing one atom of sodium united with one atom of chlorine, it seems hardly necessary to assume that all the individual atoms of sodium on the one hand, or of chlorine on the other, have precisely the same weight. It would seem to be sufficient to consider the numbers 23 and 35·5 as expressing not the relative individual weight, but the relative average weight of the atoms of sodium and chlorine.

Dr. **Divers** said there was one point he would like to refer to, and that was whether, in sodium-chloride, for instance, the sodium and the chlorine existed as such. On bringing together chlorine and sodium, the two united, with production of intense heat, and forming a compound as different from either sodium or chlorine as these were from one another. True we could obtain these elements from the compound, but we could not say they exist in it as such. We know nothing of the structure of complex substances, only that by certain reactions they yield certain products. It is quite possible, therefore, that although we get out the same elements from two isomeric bodies, these may differ in the amount of force they contain.

Dr. **Williamson** remarked that, although it was a question of very great difficulty to decide upon things so remote from our senses as these minute particles of which matter was built up, yet it was no more unreasonable to do so than with the enormous masses in the remote regions of our planetary system. He must say that those who considered it simply the part of science to record the results of observations, and not to endeavour to connect them with one another, know not what science was. A theory different from the atomic theory would be very valuable by reason of its giving us another point of view from which we might behold the facts with which we are acquainted. He would hail such a theory with delight.

Mr. **Atkinson** said it would be unnecessary for him to reply, as most of the points raised had been refuted by subsequent speakers.

The **Chairman** was inclined to think that the representation of facts by symbols without connection with some theory, was very like a body without a soul; the human mind could never rest satisfied simply with the outside representation of things, but would look for the causes which connect them. From about 1808 to 1820, the dynamical theory advanced by Kant was generally employed in Germany, and it is remarkable that no great discoveries were made, and that no eminent chemists existed there during that period, whilst in England and in France, where the atomic theory was adopted, science advanced rapidly. When, however, Germany adopted the atomic theory, chemistry at once began to improve. These things spoke for themselves.

Mr. C. **O'Sullivan** then read a paper "*On the Transformation Products of Starch*," in which the author referred to the experiments of Musculus, Payen, and Schwarzer, which he repeated, but only obtained results partly agreeing with theirs. This induced him to undertake a series of experiments to ascertain what were really the products of the transformation of starch under the influence of malt extract and of acids. The paper contains a detailed account of the numerous and carefully conducted experiments made with this object; the most important point being that he obtained, as the end product of the action of malt extract on starch, a sugar, *maltose*, isomeric with lactose, which only reduces two-thirds of the cupric oxide which dextrose does. By the continued action of acids it is converted into dextrose.

Dr. **Debus**, after thanking the author, announced that the Faraday lecture would be given by Professor Cannizzaro, of Palermo, "Sur les Limites et sur la Forme de l'Enseignement Theorique de la Chimie dans les Universités," at the Royal Institution, on Thursday, the 30th of May, at 8 o'clock.

NOTICES OF BOOKS.

Natural Philosophy for General Readers and Young Persons. Translated and edited from Ganot's "Cours Elémentaire de Physique." By E. **Atkinson**, Ph.D., F.C.S., Professor of Experimental Science in the Staff College. London: Longmans and Co., 1872. 522 pp.

This work has its origin in an attempt to comply with a suggestion that Dr. Atkinson should prepare an abridged edition of his translation of Ganot's "Elements de Physique," which could be used for purposes of more elementary instruction than that work, and in which the use of mathematical formulæ would be dispensed with. But such an adaptation Dr. Atkinson found incompatible with the nature of the larger work, and he therefore turned his attention to the translation of another book, by the same author, the "Cours Elémentaire de Physique." But Dr. Atkinson does not perform merely the mechanical part of a translator; for he has made many additions to the work, experience having taught him that such additions and even alterations would be necessary before the work could be introduced to the middle and upper classes of boys' and of girls' schools in England. Our scholastic *régime*, though in some cases founded upon, differs in essential particulars from, that pursued in French schools. On the Continent, schools are much better furnished with elementary apparatus than with us, while in their attention to detail our neighbours keep the apparatus they possess in much better order than we. The work under notice treats of the general properties of matter, hydrostatics, the properties of gases, acoustics, heat, light, magnetism, and electricity. While the illustrations to many of our scientific school-books are, in the extreme, poor in design, those of our continental neighbours are generally attractive little sketches, much more likely to make an impression upon a youth's fancy. In this case Dr. Atkinson has done well to retain the original woodcuts. Take, for instance, the engraving representing the action and mode of connection of the electric telegraph. First, there is represented a battery and simple Morse instrument when the circuit is broken; then with the circuit completed, and the armature attracted. These illustrations are shown with a second wire; next follows a lucid description how one of these wires is rendered unnecessary by the formation of an earth connection; and finally, there are two woodcuts, in admirable detail, exhibiting the sending and the receiving-clerks at work. In this manner Dr. Atkinson vividly pictures the practical applications of science to the student's eye, a terse description completing the elucidation. There will be found, we are sure, no book more acceptable whether to the teacher or the student.

CORRESPONDENCE.

LECTURE ILLUSTRATIONS.—ACTION OF LENSES.

To the Editor of the Chemical News.

Sir,—In the last number (April) of the *Quarterly Journal of Science* I was interested with the ingenious plan suggested by Dr. Ferguson for the construction of a vertical lantern with very simple materials. I have tried his plan and find that it is very effective. I would suggest also another simplification (*i.e.*) to replace the photographic or other objective lens by a watch-glass filled with water. This will produce a lens which, if the other parts of the apparatus are well proportioned, will give a very excellent image. Following out this suggestion, I find that a very striking popular illustration of refraction and its relation to the formation of images by lenses may be thus arranged. Placing as an object in the field of the ordinary vertical lantern some strongly-marked pictures, such as a photograph of a statue, we arrange an empty watch-glass in the place of the objective. There will then appear in the screen only a nebulous mass of light showing no detail of the object. On now pouring water into the watch-glass a clearly-defined image will make its appearance as soon as the liquid comes to rest. Emptying the glass and re-filling it with alcohol or any other highly refracting liquid, such, for example, as a solution of the chloride of tin, the image will appear out of focus until the lens is brought nearer to the object, when a correspondingly enlarged image will be formed. This method might, in fact, be applied to the measurement of indices of refraction.

That so rude a lens as a watch-glass full of water will make a good image, comes from the fact that the rays which go to form any one point of the image are not transmitted by the objective as a whole (as is the case with an ordinary camera lens or a telescope), but pass through a small element of the lens only, and, hence, are affected by a minute spherical and chromatic error, and not by that due to the entire aperture of the lens.* As a consequence of this, such a shape as will best secure flatness of field without reference to spherical or chromatic correction gives the best general effect, and this condition is very well secured by a common plano-convex lens with its curved surface towards the object.

A similar result is arrived at in quite another way in that very remarkable combination the Zentmayer view lens,† which, while entirely without correction in the usual sense (being made of only one kind of glass) is yet so *correct* that it compares favourably with the best corrected lenses. It has a small diaphragm at its centre, and thus the rays that form any point of the image are limited to passage through a correspondingly small element of the lens. It thus acts like a group of minute lenses, each one of which produces a different part of the picture. This lens involves many other interesting points as causes of its remarkable efficiency, but I would only cite this one in illustration of the general principle noticed above.—I am, &c.,

Henry Morton.

Stevens's Institute of Technology,
Hoboken, New Jersey.

DR. ANGUS SMITH'S RESEARCHES ON THE ATMOSPHERE.

To the Editor of the Chemical News.

Sir,—In reading Dr. Smith's admirable book on "Air and Rain," I was struck with the fact that the atmosphere is liable to pollution on much the same scale as drinking-water. In the air of "Innellan," for instance, Dr. Smith found "free" and "albumenoid" ammonia in the proportion of 52·3 grammes of "free" and 137·8 grammes of "albumenoid" in one million cubic metres of air. One kilogramme of the air of Innellan, therefore, contains 0·04 milligramme of free ammonia and 0·11 milligramme of albumenoid ammonia.

Translating Dr. Smith's table, which occurs on page 438 of his book, we have—

In one kilogramme of air:—

	Milligrammes.	
	Free Ammonia.	Albumenoid Ammonia.
Innellan	0·04	0·11
London	0·05	0·12
Glasgow	0·06	0·24
A bedroom	0·08	0·19
Inside and outside office at Manchester	0·10	0·20
Underground Railway, Metroplitan..	0·06	0·29
A midden..	0·26	0·31

This very interesting Table shows that pure air from the country and open parts of healthy towns is nearly, but not quite, as free from organic impurity as good drinking water, and that a kilogramme of air from the neighbourhood of a midden contains very nearly as much impurity as a kilogramme of water from a bad well.

Dr. Smith's determinations of the chlorides and sulphates in the air of different places admit likewise of convenient expression in the kilogramme scale.

In venturing to suggest that the new air analyses should be expressed on the kilogramme scale, I have in view the possibility of examinations of air becoming popular, as examinations of drinking-water have become. With this object in view, a simple method of registering results assumes some degree of importance, and I have accordingly put forward that which appears to me to be the simplest kind of notation.—I am, &c.,

J. Alfred Wanklyn.

ATOMIC THEORY.

To the Editor of the Chemical News.

Sir,—I should feel much obliged if you could afford me space to make one or two observations on a paper entitled, "An Examination of a Recent Attack upon the Atomic Theory," which was read before the Chemical Society on the 16th inst., and of which a report will doubtless appear in the current number of your journal.

Mr. Atkinson, the author of the above-mentioned paper, made one or two remarkably strange assertions. After quoting the results obtained by Roscoe in the analyses of the tungsten chlorides he said—"From this example it will be seen that the law of multiple proportions cannot be termed an experimental fact;" and again some time afterwards, "It has been shown above that the law of multiple proportions is not an experimental fact." I was afraid that I had forgotten what the term "law" meant as employed when discussing questions in physics, so on reaching home, I turned up my "Whately's Logic," and there found that the term "law of nature"—I presume the law of multiple proportions is one—is used "to denote the statement of some general *fact*, the several instances of which exhibit a conformity to that statement;" or, in other words, a physical law is a

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* *Journal of Franklin Institute*, 1867, vol. liv., p. 339.
† *Ibid.*, vol. lii., p. 63, and vol. lvi., p. 152.

generalisation of *facts*. Can you tell me, Mr. Editor, whether Whately is right or Mr. Atkinson?

From what the latter gentlemen said, it might be inferred that the *law* of multiple proportion is founded on the atomic *theory*. I always thought, in my ignorance, that the reverse was the case, and that theories should be founded on laws. It might be imagined that Kepler derived his well-known laws from Sir Isaac Newton's theory of gravitation, but unfortunately he had been dead a dozen years at the time the latter was born.—I am, &c.,

An Aggrieved Atom.

WASTE OF SULPHUR AND LOSS OF NATIONAL WEALTH.

To the Editor of the Chemical News.

Sir,—Whilst minerals of every description are rising in value, it will scarcely be credited, although such is the fact, that in several of the tin mines in Cornwall at the present time, a large source of what ought to produce wealth is allowed to be wasted.

Large quantities of sulphurous fumes are allowed to pass off daily in calcining the tin stuff instead of manufacturing it into sulphuric acid.

I know of an instance where three tons of sulphur are daily allowed to escape, which if manufactured into sulphuric acid, the present price of which is £3 10s. per ton, would yield a revenue of more than £12,000 a year.

Whilst Spain and Portugal and other parts of Europe are ransacked to find sulphur ores to supply the manufacturers of sulphuric acid, in Cornwall all these sources of wealth are allowed to be wasted.—I am, &c.

W. H. Tayler, M.D.

Tudor House, Anerley, Surrey,
May 14, 1872.

RELATIONS BETWEEN THE ATOMIC WEIGHTS OF CANNIZZARO.

To the Editor of the Chemical News.

Sir,—As several papers have recently appeared both in this country and on the Continent, on the subject of "Relations between the Atomic Weights of Cannizzaro," may I be permitted to remind your readers that most of these relations were pointed out in a paper written by myself, and published in the Chemical News for July 30, 1864 (vol. x., p. 59). In a subsequent paper, published in the Chemical News for August 20, 1864 (vol. x., p. 95), I showed that the elements belonging to the same group stood to each other in a relation similar to that between the extremes of one or more octaves in music. In the Chemical News for August 18 and 25 1865 (vol. xii., pp. 83 and 94), I discussed the whole question; and on March 1, 1866, read a paper on the subject before the Chemical Society, when I showed that it was only with the atomic weights of Cannizzaro that such extremely simple relationship could be observed, thereby constituting an independent argument in favour of this system of atomic weights.

As a former not unfrequent writer in your journal, may I request the insertion of the above few lines to vindicate my priority in this matter.—I am, &c.,

John A. R. Newlands, F.C.S.

9, Mincing Lane, E.C., May 21, 1872.

NOTES AND QUERIES.

Free Acid in Superphosphate.—Will some of your able readers inform me if it is possible to find free sulphuric acid in superphosphate, containing at the same time precipitated phosphate and neutral phosphate of lime?—Ignoramus.

Corrosion of Steam Chests and Cylinders.—Will some reader kindly supply information respecting corrosion of steam chests and cylinders, especially in connection with different kinds of grease employed?—K.C.

Chemical Works.—Will any of your readers kindly furnish me with some information respecting the titles, prices, and places for purchasing the chemical works of Messrs. Kunkel, Neri, and Fontaineu, more especially the latter?—Eubœa.

MEETINGS FOR THE WEEK.

Monday, May 27th.—Royal Geographical 1 (Anniversary).
—— London Institution, 4. Prof. Bentley, F.L.S., "On Elementary Botany.
Tuesday, 28th.—Civil Engineers, 8.
—— Royal Institution, 3. E. B. Tylor, F.R.S., "On the Development of Belief and Custom amongst the Lower Races of Mankind."
Wednesday, 29th.—Society of Arts, 8.
Thursday, 30th.—Royal, 8.30.
—— Royal Institution, 3. Prof. Tyndall, LL.D., F.R.S., "On Heat and Light."
—— London Institution, 7.30. Mr. W. N. Hartley, F.C.S., "On Experimental Evidence against the Spontaneous Generation of Living Things."
Friday, 31st.—Royal Institution, 9. Mr. E. J. Poynter, "On Old and New Art."
Saturday, June 1st.—Royal Institution, 3. Prof. Roscoe, F.R.S., "On the Chemical Action of Light."

TO CORRESPONDENTS.

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THE CHEMICAL NEWS.

Vol. XXV. No. 653.

ON THE LAST NEW METAL, INDIUM.[*]

By WILLIAM ODLING, M.B., F.R.S.
Fullerian Professor of Chemistry, R.I.

(Continued from page 249).

A very notable point with regard to the last-discovered four elements, namely, rubidium, cæsium, thallium, and indium, is their successive discovery within a few years of each other, by one and the same process, namely, that of spectrum analysis. This process, invented and made available as a means of chemical research by Bunsen and Kirchhoff in 1859, consists simply in allowing the light given off by different ignited gases and vapours, limited by means of a fine slit, to pass through a prism or succession of prisms; and in observing the so-produced, brightly-coloured, widely-extended image of the slit. It has been known from the days of Newton, that by the passage of heterogeneous light through a prismatic highly dispersive medium, its differently refrangible constituents become widely separated from each other, so as to furnish an elongated coloured spectrum. But whereas the spectra of incandescent solid and liquid bodies are continuous, and not distinctive of the particular luminous bodies yielding them, the spectra of incandescent gaseous or vaporised bodies are found to be discontinuous, and to consist of one or more bright lines of different colour, thickness, and position, according to the nature of the particular incandescent gases or vapours from which the light through the slit is proceeding. In this way it is found that the spectra of the different chemical elements, alike when free and in combination, are perfectly definite, and characteristic of the particular elements vaporised and made incandescent.[*] And in many cases, the spectra or portions of the spectra of particular elements, even when present in the most minute proportion, are so extremely well marked and distinctive, that the presence or absence of these elements is determinable with the greatest ease and certainty, by a mere inspection of the emission spectra yielded by the incandescent gases or vapours under examination. Moreover, gases and vapours are further capable of affecting heterogeneous light which is passed through them; and of thus yielding absorption spectra, in which the characteristic lines of the above-described emission spectra are reversed, so as to appear, unaltered in position, as black lines or intervals in an otherwise continuous band of colour.

Now the salts of the alkali-metals, lithium, sodium, and potassium, and certain of the salts of the alkaline-earth metals, calcium, strontium, and barium, being very readily volatile, upon heating these salts, in the non-luminous flame of a Bunsen gas-burner for example, they undergo vaporisation, and their vapours become incandescent and capable of yielding the characteristic emission spectra of the particular metals. In examining in this way the alkali-salt residue of a mineral water from Durkheim, Bunsen observed in the spectrum before him certain coloured lines not belonging to any one of the then known alkalies, potash, soda, or lithia; and yet necessarily belonging to some substance having the general characters of an alkali, since all other bodies than alkalies had been previously removed from the residue under examination. In full reliance upon the certainty of this conclusion, Bunsen evaporated some forty tons of the water in question; and from the alkali-salt residue, succeeded in extracting and separating salts of two new alkali-metals, each characterised by a well-marked pair of lines in the blue or indigo, and one of them having in addition a pair of well-marked lines of extremely small refrangibility in the red of the spectrum. From its yielding those red lines, the one metal was named rubidium; the other, of which the bright blue lines were especially characteristic, being called cæsium.

The very general distribution in nature of these two elements was speedily established, and salts of each of them were, with much labour, eventually prepared in a state of purity and in reasonable quantity. From certain of their respective salts the metals themselves were obtained by the usual processes, and together with their salts, were submitted to detailed chemical examination. And no sooner was this examination made, than the position of the newly-discovered elements, as members of the alkali-metal family, at once became apparent. Rubidium and cæsium were found in all their properties to present the most striking analogy to potassium, and evidently to stand to this metal in the same relation that strontium and barium respectively stand to calcium; while they differed from sodium much as strontium and barium respectively differ from magnesium. This relationship in obvious properties was further borne out by the relationship of their atomic weights, thus:—

Mg 24	Na 23	F 19	O 16
Ca 40	K 39	Cl 35·5	S 32
Sr 87	Rb 85	Br 80	Se 79
Ba 137	Cs 133	I 127	Te 129

It is observable that the sequence of atomic weight in the thus completed alkali-metal family, is strictly parallel to the previously well-known sequences in the alkali-earth metal family, and in the halogen and oxygen families respectively. Moreover, just as the basylity of the alkaline-earth metals increases in the order of their several atomic weights—calcium being less basylous than strontium, and far less basylous than barium—so also is the basylity of potassium inferior to that of rubidium, and the basylity of rubidium inferior to that of cæsium, which is indeed the most powerfully basylous, or oxidisable, or electro-positive element known.

Since 1860, both rubidium and cæsium have been recognised as minute constituents of a considerable number of minerals and mineral waters, rubidium having been met with for the most part in a larger proportion by weight than cæsium. Unlike potash, originally known as vegetable alkali, cæsium has not been recognised in the vegetable kingdom; but rubidium has been found as a very common minute constituent of vegetable ashes, as those of beet-root, oak-wood, tobacco, grapes, coffee, tea, &c., On the other hand, cæsium, free from rubidium, has been found in a tolerably well-known, though rare, mineral from the Island of Elba, to the extent of 32 per cent by weight of the mineral. The history of this mineral is curious: from the circumstance of its always occurring in association with another mineral, a variety of petalite, the two were called Castor and Pollux. Castor was found to be substantially a silicate of alumina and lithia; pollux a silicate of alumina, and, as it was thought, of potash. The constituents of pollux, namely, silica, alumina, and potash, with small proportions of ferric oxide, lime, soda, and water, were duly estimated; but the quantities of these constituents, found in 100 parts of the mineral, instead of amounting to 100 parts or thereabouts, amounted only to 88 parts, there being somehow a loss of 12 per cent in the analysis. After Bunsen's discovery of the new alkali-metals, pollux was analysed afresh by Pisani, who soon perceived that what had formerly been taken for potash, and estimated as potash, was not potash at all, but cæsia. Then calculating out his own analysis with cæsia instead of potash, substituting the one for the other in the proportion of 133+8, or 141 parts of cæsia, for 39+8, or 47 parts of potash, he found that the quantities of the different constituents furnished by 100 parts of the mineral yielded by their addition the full sum of 100 parts required.

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[*] Read before the Royal Institution of Great Britain.

[*] For some qualifications of this statement, *vide* Roscoe's "Spectrum Analysis."

In submitting to spectroscopic examination a certain residue left by the distillation of some impure selenium, Mr. Crookes, early in 1861, recognised in the spectrum before him a brilliant green line, from which he inferred the presence in the above residue of a new element; and by the end of the same year, he had succeeded in establishing the tolerably wide distribution of this element, to which he gave the name of thallium; in procuring it, though but in small quantity, in a separate state; and in satisfying himself of its metallic character. Soon afterwards, and without knowledge of Mr. Crookes's later results, the metal was obtained by M. Lamy on a comparatively large scale, and was exhibited by him in the form of small ingots at the London Exhibition of 1862. He procured it from the fine dust met with in some oil of vitriol factories, as a deposit in the flues leading from the pyrites burners to the leaden chambers. In these deposits, the minute proportion of thallium contained originally in the pyrites becomes concentrated, so as to form in some instances as much as 8 per cent by weight of the dust. Independently, moreover, of its occurrence in iron pyrites, thallium, though never forming more than a minute constituent of the different minerals and mineral waters in which it occurs, is now known to be capable of extraction from a great number and variety of sources. But from no other source is it so advantageously procurable as from the above-mentioned flue deposit; and so early as the autumn of 1863, at the meeting of the British Association in Newcastle, the then mayor, Mr. I. Lowthian Bell, exhibited several pounds, and Mr. Crookes no less than a quarter of a hundredweight of thallium obtained from this comparatively prolific source. In one respect, the discovery of thallium presented even a greater degree of interest than attached to the discovery of cæsium and rubidium. For whereas these two elements were at once recognised as analogues of the well-known metal potassium, thallium can hardly be said, even at the present time, to be definitely and generally recognised by chemists as the analogue of any particular metal, or as a member of any particular family of elements. With each of such differently characterised elements as potassium, lead, aluminum, silver, and gold, it is associated by certain marked points of resemblance; while from each of them it is distinguished by equally well-marked points of difference. Hence the necessity for subjecting thallium and its salts to a thorough chemical examination, so as to accumulate a well-ascertained store of facts with regard to it. And thanks to the careful labours of many chemists, more particularly of Mr. Crookes in London, and of Messrs. Lamy and Willm in Paris, our knowledge of the properties of thallium and of its salts may compare not unfavourably with our similar knowledge in relation to even the longest known of the metallic elements. Still it was not until our knowledge of indium had culminated in the determination of its specific heat only last year, that the position of thallium as an analogue of indium, and a member of the aluminum family of elements became unmistakably evident.

Indium was first recognised in 1863, by Drs. Reich and Richter, in the zinc blende of Freiberg in Saxony, and by reason of the very characteristic spectrum afforded,—consisting of two bright blue or indigo bands; the brightest of them somewhat more refrangible than the blue line of strontium, and the other of them somewhat less refrangible than the indigo line of potassium. Since its first discovery, indium has been recognised in one or two varieties of wolfram, and as a not unfrequent constituent of zinc ores, and of the metal obtained therefrom, but always in a very minute proportion. Indeed, indium would appear to be an exceedingly rare element, far more rare than its immediate predecessors in period of discovery. Its chief source is metallic zinc,—that of Freiberg, smelted from the ore in which indium was first discovered, containing very nearly one-half part of indium per 1000 parts of zinc. A considerable quantity of indium extracted from this zinc was shown in the Paris Exhibition of 1867; and an ingot from the Freiberg Museum, weighing 200 grms., or over 7 ounces, has within the last few days been kindly forwarded by Dr. Richter himself, for inspection on the present occasion. To Dr. Schuchardt, of Goerlitz, also, the members of the Institution are indebted for his loan of nearly 60 grms. of metallic indium; and of fine specimens of other rare chemical products, prepared with his well-known skill, in a state of great purity and beauty.

When zinc containing indium is dissolved not quite completely in dilute sulphuric or muriatic acid, the whole of the indium originally present in the zinc is left in the black spongy or flocculent residue of undissolved metal, with which everyone who has prepared hydrogen gas by means of zinc and acid is so well acquainted. Besides some zinc, this black residue is found to contain lead, cadmium, iron, and arsenic, less frequently copper and thallium, and in some cases, as that of the Freiberg zinc, a small proportion of indium. From the solution of this residue in nitric acid the indium is separated by ordinary analytical processes, based chiefly on the precipitability of its sulphide by sulphuretted hydrogen from solutions acidulated only with acetic acid; and on the precipitability of its hydrate both by ammonia and carbonate of barium. From its soluble salts, metallic indium is readily thrown down in the spongy state by means of zinc. The washed sponge of metal is then pressed together between filtering paper, by aid of a screw press, and finally melted under a flux of cyanide of potassium.

Thus obtained, indium is a metal of an almost silver-white colour, apt to become faintly bismuth-tinted. It tarnishes slowly on exposure to air, and thereby acquires very much the appearance of ordinary lead. Like lead, it is compact and seemingly devoid of crystalline structure. Moreover, like lead and thallium, it is exceedingly soft, and readily capable of furnishing wire, by the process of "squirting" or forcing. The specific gravity of indium, or 7·4, is very close to that of tin, or 7·2; and much above that of aluminum, 2·6, and below that of lead, 11·4, and that of thallium, 11·9. In the lowness of its melting-point, viz., 176° C., indium occupies an extreme position among the metals permanent in air; the next most fusible of these metals, viz., tin and cadmium, melting at 228°, bismuth at 264°, thallium at 294°, and lead at 235°. Though so readily fusible, indium is not an especially volatile metal. It is appreciably less volatile than the zinc in which it occurs, and far less volatile than cadmium. Heated as far as practicable in a glass tube, it is incapable of being raised to a temperature sufficiently high to allow of its being vapourised, even in a current of hydrogen.

Indium resists oxidation up to a temperature somewhat beyond its melting-point, but at much higher temperature it oxidises freely; and at a red heat it takes fire in the air, burning with a characteristic blue flame and abundant brownish smoke. It is readily attacked by nitric acid, and by strong sulphuric and muriatic acids. In diluted sulphuric and muriatic acids, however, it dissolves but slowly, with evolution of hydrogen. Oxide of indium is a pale yellow powder, becoming darker when heated, and dissolving in acids with evolution of heat. The hydrated oxide is thrown down from indium solutions by ammonia as a white, gelatinous, alumina-like precipitate, drying up into a horny mass. The sulphide is thrown down by sulphuretted hydrogen as an orange-yellow precipitate, insoluble in acetic, but soluble in mineral acids. The hydrate and sulphide of indium, in their relations to fixed alkali solutions more particularly, seem to manifest a feebly-marked acidulous character. Chloride of indium, obtained by combustion of the metal in chlorine gas, occurs as a white micaceous sublimate, and is volatile at a red heat without previous fusion. The chloride itself undergoes decomposition when heated in free air, and the solution of the chloride upon brisk evaporation, with formation in both cases of an oxychloride.

(To be continued).

ON THE

PART WHICH FERRIC AND ALUMINIC OXIDES PLAY IN THE MANUFACTURE OF SUPERPHOSPHATE;

AND ON THE

COMPARATIVE VALUE OF MINERAL PHOSPHATES.*

By T. L. PATTERSON, F.C.S.

As the consumption of phosphatic minerals in the production of artificial manures has increased to an enormous extent of late years, so it becomes a matter of the greatest importance that manufacturers should study carefully the influence of the several constituents of the raw material on the production of the manufactured article. At present, importance is only attached to the per cent of tricalcic phosphate in mineral phosphates, without regard to the other ingredients; in so much so, that most of them are purchased at a certain fixed rate for each per cent of this earth shown in an analysis. I will attempt, however, to show that it is equally important for manufacturers to know the per cent of calcic carbonate, ferric oxide, and aluminic oxide, as well as how they are combined, to enable them to judge correctly what is the value of any mineral phosphate for the manufacture of manure.

As I believe a phosphatic mineral is only valuable for the superphosphate which can be made from it, I intend treating the subject from what I may call a decomposition point of view; and in the first part of this paper will discuss the reactions which take place when sulphuric acid is added to a mineral phosphate containing ferric and aluminic oxides, and describe some experiments in support of them. In the second part, I will show how the comparative value of these phosphates may be calculated.

The following are the analyses of three minerals, well known in commerce, which illustrate very well all the points I wish to bring before the section:—

	No. 1.	No. 2.	No. 3.
Phosphate of lime	50·90	54·25	51·67
Phosphate of magnesia	a little	0·55	0·35
(= phosphate of lime)	—	(0·77)	(0·49)
Calcic carbonate existing partly as calcic fluoride and chloride	9·64	24·47	14·55
Calcic sulphate	1·72	2·57	4·03
Ferric oxide	6·96	2·03	1·06
Ferrous oxide	—	0·34	0·42
Aluminic oxide	4·18	1·75	0·89
Silica and sand	18·44	8·62	17·21
Loss on ignition	3·97	4·37	5·45
Loss at 100° C.	3·75	1·08	4·00
	99·56	100·03	99·63

When sulphuric acid is added to a phosphate such as No. 1, in quantity insufficient to render all the bases soluble, double decompositions represented by some or all of the following equations will be the result. To avoid complexity, I will not include the water of hydration:—

(*a*). $CaCO_3+SO_3=CaSO_4+CO_2$.
(*b*). $Ca_3(PO_4)_2+2SO_3=Ca(PO_3)_2+2CaSO_4$.
(*c*). $Fe_2O_3+3SO_3=Fe_2O_3,3SO_3$; and
(*d*). $Fe_2O_3,3SO_3+Ca(PO_3)_2=2FePO_4+CaSO_4+2SO_3$, or—
(*e*). $Fe_2O_3,3SO_3+Ca_3(PO_4)_2=2FePO_4+3CaSO_4$, or
(*f*). $3(Ca(PO_3)_2)+2Fe_2O_3=4FePO_4+Ca_3(PO_4)_2$, and
(*g*). $4FeSO_4+O_2+Ca(PO_3)_2+Ca_3(PO_4)_2=$
$=4FePO_4+4CaSO_4$.

Equations (*a*) and (*b*) are well-established, and need no comment. Calcic fluoride will be decomposed in the same way as calcic carbonate, and is therefore represented by (*a*). I have not shown the calcic fluoride separately in the foregoing analyses, because, for the purposes of the manufacturer, it is unnecessary; and the small amount of silicon carried off by the liberated hydric fluoride is of no importance in the after calculation. The estimation of fluorine, too, is difficult and tedious when present in small qnantity; and, since it serves no useful purpose, it seems to me preferable to report the calcium existing as fluoride as calcic carbonate, for, so far as the calcium is concerned, the ultimate result is the same.

The peroxide of iron and alumina will be attacked simultaneously with the phosphate and carbonate of calcium, &c., and so we might expect to have neutral persulphate of iron and neutral sulphate of alumina, or still more acid salts, formed according to equation (*c*), which in their turn react on a portion of the monocalcic phosphate just become soluble, according to equation (*d*), setting free two molecules of sulphuric acid to attack a still untouched portion of tricalcic phosphate. Or, again, we may assume that the reaction represented in equation (*e*) takes place, where a molecule of ferric sulphate decomposes one of tricalcic phosphate, with the production of two of ferric phosphate and three of calcic sulphate. Or, lastly, we may suppose, with Graham and Fresenius, that the acid attacks the calcic carbonate and phosphate in the first instance, then the soluble monocalcic phosphate gradually reacts on ferric and aluminic oxides, producing in the course of time the so-called "reduced phosphates," as represented by equation (*f*), where three molecules of monocalcic phosphate are decomposed by two of ferric oxide into four of ferric phosphate and one of tricalcic phosphate.

Ferrous oxide when present simply replaces lime; but in the course of time, as it gradually absorbs oxygen, a portion of monocalcic phosphate will be precipitated, as shown in equation (*g*).

No single one of these equations, however, in my opinion, represents exactly the true decomposition of a mineral phosphate on the addition of sulphuric acid. Yet I think two or more of them are sufficient to do so. The ferric and aluminic oxides exist partly in a hydrated and partly in an anhydrous condition, or, at any rate, one portion seems to be more hydrated than another. It is thus likely that equations (*c*) and (*d*), (*c*) and (*e*), or (*c*), (*d*), and (*e*), represent actions which take place simultaneously with those represented by (*a*) and (*b*), the hydrated oxides of iron and aluminium taking part in the reaction; and afterwards, when the resulting superphosphate is kept for some time, the decomposition represented in equation (*f*) takes place, through the action of a portion of the oxide of iron and alumina which remained unattacked in the process of manufacture. The following experiments were made in order, if possible, to throw some light on the decomposition of these minerals:—

Expt. 1.—A portion of No. 2 phosphate had a red colour after ignition, while superphosphate made from it, subjected to the same treatment, had a light grey colour. This was also the case with No. 1 phosphate, and shows that, whatever be the reaction, the ferric oxide was not combined with phosphoric acid in the mineral, while it was in the superphosphate.

Expt. 2.—A sample of another phosphate which gave 10·52 per cent of ferric and aluminic oxides and 18·90 per cent of sand, when digested with dilute HCl, yielded *after ignition* only 5·79 per cent of these oxides to the acid solution, and the residue weighed 23·26 per cent. When this residue was boiled with HNO_3, and the solution tested with molybdate of ammonia, it was found free from phosphoric acid. The residue of the ignited portion was 4·36 per cent in excess of that of the mineral before ignition. And 4·36+5·79=10·15, a result closely corresponding with the percentage of ferric and aluminic oxides found in the non-ignited mineral. Now it is well known that hydrates of these oxides are less soluble after than before ignition, and this experiment shows that they were

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* Read before the Chemical Section of the Glasgow Philosophical Society.

present in this mineral in that form. As all these minerals lose weight on ignition, over and above what they lose at 100° C., we may assume that the loss is principally water of hydration, and that it is in combination with iron and aluminium oxides. (Some of them contain organic matter, which is also driven off on ignition, but it usually exists only in small quantity. It seems, however, to exert a reducing action on the ferric oxide, retaining a portion in the condition of ferrous oxide. Nos. 3 and 2, which contain most organic matter, have also most ferrous oxide, and No. 1, having little more than a trace, contains none of that oxide).

Expt. 3.—When a portion of any of these minerals, but especially No. 1, which contains most ferric and aluminic oxides, was digested with a solution of citrate of ammonia of 1·09 sp. gr. for about an hour on the top of the water-bath, and filtered, the filtrate had a very yellow colour, owing to the solution of a portion of the red oxide of iron. All the iron is not rendered soluble by this treatment, as the residue still remains coloured. This is, doubtless, due to the intimate admixture of the molecules of ferric and aluminic oxides with the other ingredients of the mineral, so that it would be practically impossible to separate the whole of these oxides by this means. That a portion is attacked, however, and goes into solution, is another proof, I think, that they exist—partly, at least,—in the hydrated form.

Expt. 4.—A mineral phosphate was dissolved with excess of dilute sulphuric acid, water added, and the whole thrown on a filter. To the filtrate, which contained ferric and aluminic oxides, ammonia was added, until a permanent precipitate was formed. The precipitate was filtered off, and the filtrate, which was now in the most neutral condition possible, was used to make further experiments.

Expt. 5.—To a portion of the filtrate from Expt. 4, pure tricalcic phosphate was added. The clear solution filtered from this mixture gave abundant evidence of iron with ferrocyanide of potassium; but, after standing some days, the filtrate only showed a minute trace of that metal when tested with the ferro- and sulpho-cyanides of potassium. The ferric sulphate in the original solution is thus shown to have decomposed a portion of the tricalcic phosphate, with production of ferric phosphate and calcic sulphate, as represented in equation (*e*).

Expt. 6.—To a second portion of the same solution was added a solution of alumina ammonia alum, but even after standing some days it remained quite clear. Pure precipitated tricalcic phosphate was now added. After the lapse of eight or ten days, the mixture was filtered, and tested with ammonia and acetic acid; an abundant precipitate of aluminic phosphate was obtained. When the solution was boiled with tricalcic phosphate filtered and tested as before, a much less abundant precipitate was obtained. Thus we see that although neutral phosphate of calcium cannot remove alumina from a solution in the cold, yet it does so to a great extent when heated.* And, as all superphosphate becomes highly heated in the process of its manufacture, this reaction explains the reason why so little aluminic oxide is found in an aqueous extract. Its precipitation in this way is doubtless similar to that of ferric oxide as represented in equation (*e*).

Expt. 7.—To a third portion of the filtrate from Expt. 4 was added a solution of ferric ammonia alum, this being probably one of the most neutral salts of that base. The mixture remained quite clear at first, but in the course of a minute a white flocculent precipitate separated, which gradually increased on standing for some hours. Warington has already shown that the addition of an alumina salt to a solution of phosphoric acid gives no precipitate in the cold, while a precipitate goes down at once when the aluminic solution is replaced by a ferric one.* This difference between aluminic phosphate and ferric phosphate shows that the latter salt requires a greater excess of acid to retain it in solution than the former. On this account, I thought it would be interesting to determine the composition of the precipitate formed; accordingly I prepared a small portion, filtered and washed it thoroughly in the cold, and dried it in the water-bath.

0·4248 grm. lost 0·0820 grm. on ignition,
0·4248 ,, gave 0·1712 ,, Fe_2O_3, and
0·3275 ,, gave 0·2083 ,, $2MgO,P_2O_5$.

The ferric oxide was estimated with $\frac{N}{10}$ chromate of potash, after reduction with zinc, and the phosphoric acid by the molybdate process. Calculated to per cent the results are as follows, and correspond to the formula $7Fe_2O_3,8P_2O_5$.

	Calculated from the formula $7Fe_2O_3 8P_2O_5$.	Found.
Ferric oxide	40·21	40·30
Phosphoric anhydride ..	40·79	40·70
Loss on ignition	—	19·31
		100·31

When this acid phosphate of ferric oxide is digested with the citrate of ammonia solution at 38° C. it goes easily into solution, as might be expected from the known solvent power of citric acid salts for those of ferric oxide. Whether this phosphate is formed in the manufacture of superphosphate remains to be proved. It seems very probable that a small quantity is produced simultaneously with ferric phosphate; but, if it is, it is hardly possible for it to exist long as such, for the tricalcic phosphate present will soon decompose it and bring it back to its normal state.

Expt. 8.—To a fourth portion of the solution from Expt. 4 was added a solution of the double sulphate of protoxide of iron and ammonia. It remained perfectly clear for a couple of hours, when it began to be turbid, and after standing over night a considerable precipitate had separated. When this precipitate was filtered off, washed, and tested with ferricyanide of potassium, it was found perfectly free from ferrous oxide. The ferric phosphate which separated was doubtless formed as represented in equation (*g*).

Expt. 9.—To a fifth portion of the same solution I added a quantity of well-washed hydrated ferric oxide. But little change was observed for a day or two; gradually, however, the solution became opalescent, especially the supernatant fluid, when the red oxide had collected at the bottom of the glass, and the red ferric oxide became of a lighter colour. These indications of decomposition were greater after the lapse of eight or ten days; and at the end of a month they were very evident, as the ferric oxide slowly and gradually precipitated the phosphoric acid, as represented in equation (*f*). A portion of the solution removed by filtration still gave abundant evidence of the presence of phosphoric acid.

Fresenius refers to another decomposition to account for the reduced phosphates. He supposes one molecule of monocalcic phosphate to react on one of tricalcic phosphate, with the production of two of dicalcic phosphate, thus:—

$$Ca_3(PO_4)_2+Ca(H_2PO_4)_2=2(Ca_2(HPO_4)_2)\ ;$$

but no experiments being given in support of this hypothesis, and as the presence of ferric and aluminic oxides are sufficient to account for all the phenomena observed, I cannot regard this decomposition as at all probable. Now it follows, from what I have said, that all superphosphates which contain these oxides should also contain reduced phosphates. Chemists have tried to estimate them as though they were precipitated tricalcic phosphate. If a superphosphate be analysed when it is made,

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* I was unaware of the following statement in Storer's "Dictionary of Solubilities," when the above experiments were made. At p. 483 he says:—"Any insoluble (*c*) phosphate of a protoxide is completely decomposed by any soluble salt of a sesquioxide, as an alum, for example, either in the cold or at the boiling temperature, an insoluble salt of the sesquioxide being formed."

* Chemical News, vol. xxiii., p. 205.

and again at the end of twelve months or so, the phosphoric acid which has become insoluble during that period is all that can properly be called "reduced." Yet the best process which has been devised for their estimation is capable of removing from a superphosphate more than that. I happen to have had beside me for some years three samples of superphosphate, which were analysed at the time they were made. With the object, therefore, of testing the process, I have again subjected them to analysis, this time estimating the reduced phosphates by Fresenius, Neubauer, and Luck's method, in which a neutral solution of citrate of ammonia of 1·09 sp. gr. is used, as described by them in a paper "On the Best Methods for the Analysis of Mineral Phosphates and Artificial Manure."* The following are the results:—

	Sample No. 1.		Sample No. 2.		Sample No. 3*	
	a.	*b.*	*a.*	*b.*	*a.*	*b.*
Soluble phosphate	22·05	19·60	16·61	14·21	20·66	18·01
Insoluble ,,	9·63	6·32	12·42	8·17	6·70	3·91
Reduced ,,	—	5·90	—	7·05	—	4·61
Total ..	31·68	31·82	29·03	29·43	27·36	26·53

a is the composition of the superphosphate when made; *b*, the same recently ascertained.

No. 1 is a sample of 190 tons made in October, 1868.
No. 2 ,, ,, 70 ,, ,, December, 1868.
No. 3 ,, ,, 75 ,, ,, January, 1869.

These samples have thus lain in my possession for upwards of three years, during which period they have gone back in soluble phosphate of lime to the extent of—

2·45 per cent in No. 1 sample.
2·40 ,, No. 2 ,,
2·65 ,, No. 3 ,,

Thus we see that the so-called "reduced phosphates" are very much greater when estimated by this indirect method than is represented by the difference of the soluble tricalcic phosphate in the superphosphates at the time they were made, and that found in them after the lapse of three years. The citrate of ammonia filtrate comes away highly coloured with iron, because it has dissolved ferric phosphate; it has also removed aluminic phosphate and all the calcic sulphate. The insoluble residue still contains phosphoric acid, ferric oxide, and aluminic oxide, and, as in these samples it contained no lime, the phosphoric acid must have been in combination with the iron and aluminic oxides. If, then, as I have just shown, the citrate solution removes more phosphoric acid than is represented by the actual going back of the superphosphate in three years, the indirect method giving a much higher percentage for these phosphates than it ought, it is quite unsuitable for their estimation. If, on the other hand, we are to understand as reduced phosphates all phosphoric acid which has combined with ferric and aluminic oxides in the process of manufacture—there being no phosphoric acid in combination with these oxides in the raw material, while it is all combined in superphosphate; and if, moreover, it be admitted that these reduced phosphates are principally ferric and aluminic phosphates, and not neutral phosphate of lime, it is again apparent that the citrate solution cannot be used to separate them, as it failed to dissolve all the ferric and aluminic phosphates contained in the insoluble residue from the three samples above quoted.

The reduction of these superphosphates may be explained by some of the equations given above. The water solution of an artificial manure seldom contains more than a trace of ferric and aluminic oxides, even when newly made, so that the 2·45 per cent gone back in sample No. 1, for example, could not have been the result of a decomposition such as (*d*), but it is highly probable it has been formed in the way represented by equation (*f*). Any ferrous oxide which the mineral contains would, of course, also reduce a portion of the phosphoric acid as represented in (*g*); but, in any case, only one-third of the phosphoric acid reduced exists as tricalcic phosphate, the remainder being ferric and aluminic phosphates. The residue of the reduced phosphates in sample No. 1 (5·90 − 2·45 = 2·45) was in all probability never soluble at all, it having been produced in the process of manufacture according to equations (*c*), (*d*), and (*e*) together, or (*c*) and (*e*) alone.

Summarising what I have said, we see in the first place that, when a mineral phosphate is mixed with sulphuric acid, the ferric and aluminic oxides, which were originally present in the form of hydrates, become partially converted during the reaction, and completely after the lapse of an indefinite period, into the insoluble phosphates of these oxides; and lastly, that the so-called "reduced phosphates" consist principally of a portion of the phosphates so formed.

This brings me to the second part of my paper.

(To be continued).

ON SOME PROPERTIES OF CHLORAL HYDRATE.

By Dr. T. L. PHIPSON, F.C.S.

When chloral combines with water to form the solid hydrate of chloral it gives out a considerable amount of heat, but when hydrate of chloral dissolves in water, a very considerable degree of cold is produced. Half a pound of chloral hydrate mixed rapidly with half a pound of water causes the thermometer to sink many degrees below zero.

The crystalline form of pure chloral hydrate is the *oblique rhombic prism*, and the crystals are usually very neat. When these prisms are short, which is frequently the case, they may easily be mistaken for acute rhombohedra.

When minute fragments of the crystals remain suspended on the surface of pure distilled water, they move about rapidly, with the same peculiar gyratory motion that is remarked with camphor in the same circumstances.

NOTE ON THE ESTIMATION OF SULPHUR IN PYRITES.

By H. B. YARDLEY.

It is usual, in oxidising the pyrites with nitric acid, after the first violent action is over, to heat the solution in a flask having a small funnel inserted in the mouth on the sand-bath, to brisk ebullition. The high temperature thus employed, I have been told, causes a loss of sulphur and consequent incorrect result.

To prevent this *supposed* loss, some chemists oxidise the pyrites in a small covered beaker, at a lower temperature, on the water-bath.

Having doubts as to any difference in determinations by each process, I made the four following analyses:—

No. 1.—16·86 grs. oxidised at 212° gave 59·02 grs. $BaSO_4$, containing 8·09 sulphur = 47·86 per cent sulphur.

No. 2.—17·65 grs. oxidised at high temperature (undetermined and varying) gave 61·92 grs. $BaSO_4$, containing 8·49 grs. sulphur = 48·10 per cent sulphur.

No. 3.—15·35 grs. oxidised at 212° gave 1·30 unoxidised sulphur (or H_2O retained at 212°) and 11·62 $BaSO_4$, containing 1·59 sulphur: total sulphur 1·89 = 12·31 per cent, or 1·59 = 10·35 per cent.

No. 4.—15·15 grs. oxidised at high temperature gave 0·45 gr. unoxidised sulphur (or H_2O retained at 212°) and 10·83 $BaSO_4$, containing 1·52 sulphur: total sulphur 1·97 = 12·34 per cent, or 1·52 = 10·03 per cent.

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* Fresenius, *Zeitschr.*, vol. x., part 2.

Nos. 1 and 2 were of the same sample of *raw ore*, and Nos. 3 and 4 of the same sample of *cinders*. The difference in Nos. 1 and 2 is only 0·24 per cent, and Nos. 3 and 4 0·03 per cent, both on the side of high temperature, or, if the *unoxidised sulphur* was in reality H_2O retained by insoluble matters at 212°, 0·32 per cent for low temperature. All these differences, however, would be considered immaterial for commercial purposes, and are excessive for experimental purposes. I therefore come to the conclusion that no loss is occasioned by the use of a high temperature, although I have found that the low temperature, improbable as it may seem, takes less time. Just sufficient HNO_4 is added for oxidation of the sulphur, and after a half-hour's heating on the water-bath enough HCl is mixed with it to dissolve the iron, &c., and no evaporations are necessary. The precipitate of $BaSO_4$ also subsides more readily than in the other case, almost allowing the clear supernatant liquid to be poured off without filtering.

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA.

Communicated by J. W. MALLET, Ph.D., M.D.,
Professor of Analytical and Applied Chemistry, University of Virginia.

(1). *Composition of the Precipitate formed by adding a Solution of Ammonio-Sodic Phosphate to one of Calcic Chloride.* Examined by Mr. J. W. C. Davis, of Westmoreland Co., Va.

On adding to a cold moderately-concentrated solution of calcic chloride a solution of "microcosmic salt," as long as a precipitate was formed, this precipitate was found to be at first flocculent, but on standing in the supernatant fluid for twenty-four hours it became distinctly crystalline, some of the individual crystals attached to the sides of the beaker being large enough to be distinguished by the naked eye. They were colourless and transparent, and under the microscope the form was seen to be that of thin rhombic tables with plane angles of 30° and 150° respectively, the acute angles being often truncated by short planes, with plane angles as in the Figure. The precipitate was placed upon a filter, partially washed with a small quantity (not much more than its own volume) of water, a portion (A) in this condition set aside for analysis, and the remainder (B) thoroughly washed until the wash-water ceased to give any indication of the presence of chlorine, and until argentic nitrate showed but a very faint trace of phosphoric acid, which did not seem further to diminish. This latter washing lasted about two weeks, and about 5 litres of water were passed through some three grms. of the precipitate.

The partially washed portion (A) yielded, on analysis—

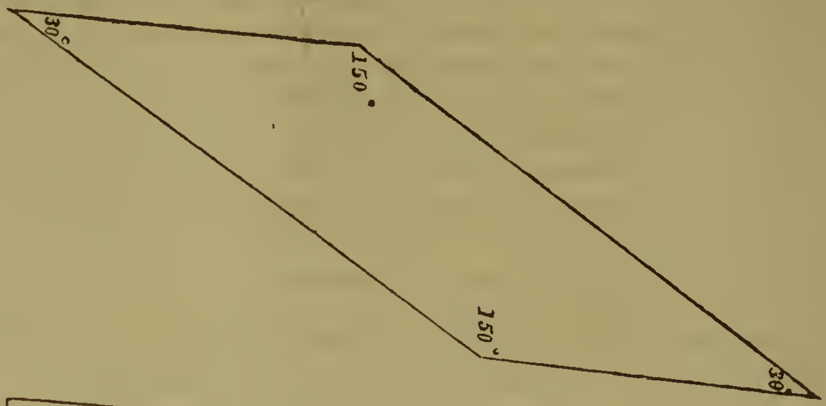
Phosphorus pentoxide.. ..	40·00
Lime	32·28
Chlorine	1·20
Water	27·05
Soda and ammonia	traces

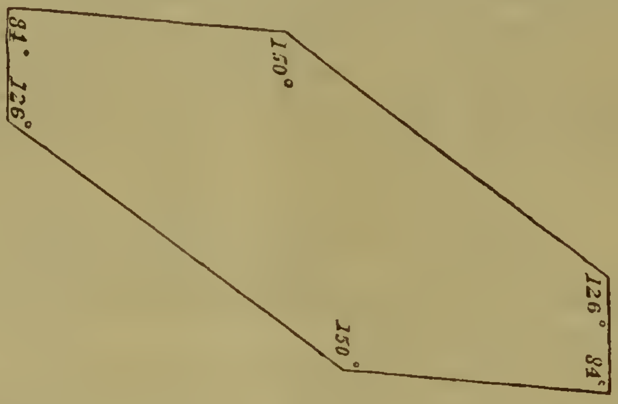
Or—

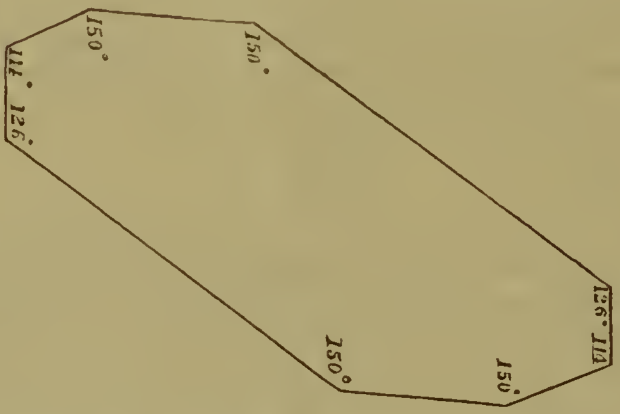
Phosphorus pentoxide.. ..	40·00
Lime	31·34
Calcium chloride	1·87
Water	27·05
	100·26

Of the water, 20·05 per cent was given off by heating up to 55° C., 1·85 per cent between 140° and 250°, and 5·15 per cent was retained until the temperature ranged from 250° to a red heat.

If the calcium chloride be assumed to have had associated with it the most usual amount of water of crystallisation ($CaCl_2+6H_2O$), and be deducted from the above results of analysis, there will remain the dicalcic ortho-phosphate with four equivalents of water ($Ca_2H_2P_2O_8+4H_2O$), described by Raewski, Bödeker, and Drevermann, as the following statement shows :—







	Found.	Calculated.
Phosphorus pentoxide ..	41·03	41·28
Lime	32·15	32·56
Water..	26·82	26·16
	100·00	100·00

The thoroughly-washed portion (B) dried, like the above, over oil of vitriol at ordinary temperature, yielded, on analysis—

Phosphorus pentoxide ..	39·88
Lime	34·02
Water	25·25
	99·15

indicating a small loss of phosphoric acid, and relative increase of lime, but affording essentially the same formula as at first. Examined with the microscope, the crystals were still transparent and unchanged in appearance, except by the angles having been more or less broken off.

(2). *Composition of Crystalline Deposit from a Solution of Magnesium and Ammonium Chloride.* By Mr. J. W. C. Davis.

A bottle containing magnesium and ammonium chloride (with excess of ammonia), prepared for use as a laboratory reagent, was found, after standing undisturbed for some months, to have become crusted on the inside with a white crystalline deposit, which under the microscope appeared as bunches of slender, colourless needles, radiating from the centres of the tufts.

Two specimens (A and B) were washed upon filters with cold water; A with a small quantity only, but enough to remove all ammonia and ammoniacal salt; B with a very much larger quantity, the washing being continued for several days until nothing more could be dissolved out.

The mean of three analyses of A proved it to be magnesium oxychloride, and afforded—

	Magnesia	45·41
	Chlorine	12·97
	Loss on heating to redness	53·50
Or—		
	Magnesium chloride	17·36
	Magnesia	38·10
	Water	43·45
		98·91

It was ascertained that the material, heated gradually to redness and kept red-hot for some time, only retained 0·0014 per cent of chlorine; in place of the chlorine driven off, oxygen had of course been taken up from the air.

The loss of weight on heating occurred at a pretty uniform rate between 65° and 225° C.

The analysis corresponds best to the formula $MgCl_2+5MgO+13H_2O$, which would require—

Magnesium chloride	17·96
Magnesia	37·81
Water	44·23
	100·00

Perhaps this may be assumed as—

$$Mg_2Cl_2O,H_2O+4(MgO,3H_2O).$$

The more complex formulæ deduced by C. Bender* for Sorel's magnesian cement were obtained from the analysis of a material which does not seem to have been crystalline, and which contained magnesium carbonate.

The substance (B), thoroughly exhausted by washing with cold water, and air-dried, had lost distinctness of crystalline form and was found to contain no chlorine. It was a magnesian hydrate, and yielded results intermediate between those of the simple formula MgO,H_2O, and of the formula found by Bender (*loc. cit.*), viz., $4MgO,5H_2O$.

	Found.	Calculated (MgO,H_2O).	Calculated ($4MgO,5H_2O$.)
Magnesia	66·33	68·96	64·00
Water	33·67	31·04	36·00
	100·00	100·00	100·00

In all probability the merely air-dried material retained a little non-essential water, and the former of these formulæ really represents the substance as obtained from the source now in question.

(3). *Analysis of an Anomalous Variety of Stannite (Tin Pyrites) from Cornwall.* By Mr. J. B. Adger, of South Carolina.

A specimen of "bell-metal ore" from Cornwall, massive, but apparently very uniform in character, of steel-grey colour inclining to yellowish-grey, with metallic lustre, finely granular fracture, and specific gravity = 4·46 at 12° C., was analysed with the following results, leading very distinctly to the formula $8(\text{Ȼu}FeZn)S+3SnS_2$, instead of the usual $2(\text{Ȼu}FeZn)S+SnS_2$.

		Percentage divided by atomic weight.		
Sulphur ..	27·945	0·8733		14·00
Tin	22·037	0·1868		2·99
Copper.. ..	27·771	(0·4373 ÷ 2) = 0·2186		
Iron	12·749	0·2277	0·5020	8·05
Zinc	3·618	0·0557		
Insoluble (quartz)	6·390			
	100·510			

One would be inclined to suspect the (not uncommon) intimate admixture of normal stannite with copper pyrites, were it not for a want of sulphur enough to meet this view, and the very close accordance of the figures actually obtained with the above irregular formula. There were some small fragments of copper pyrites attached to a part of the specimen, but they were plainly distinguishable, and easily picked out.

The only other accompanying mineral was wolfram.

(4). *Composition of the Deposit from Retorts in which Carbon Disulphide had been made.* By Mr. F. P. Dunnington, of Baltimore.

A specimen of the deposit, or rather crust, removed from cast-iron retorts in which the manufacture of carbon disulphide had been carried on at the establishment of Mr. Jesse Fisher, Phœnix Chemical Works, Ironbridge, (England), presented the appearance of a nearly black mass, with traces of bronze-yellow colour, of about 33 m.m. thick, divisible by the eye into three tolerably distinct but closely united layers, of which that (No. 1) which had obviously been in contact with the iron was about 6 m.m. thick, granular in fracture, pretty compact, of black colour, and imperfect metallic lustre; the middle one (No. 2) about 10 m.m. thick, very finely granular in fracture, still more compact, of dark blackish-grey colour, and imperfect metallic lustre; while the one (No. 3) which had been farthest from the iron, or nearest the interior of the cylinder was about 17 m.m. thick, distinctly crystalline, with slender prismatic structure (the long axes of the prisms at right-angles to the surface of the iron), less compact than either of the other two, of dark yellowish-grey colour, and distinct metallic lustre when freshly broken, most of the surface covered with an iridescent tarnish. The specific gravity, taken with the material in powder, and boiled with water to expel air, was found to be for No. 1, 3·69; for No. 2, 3·72; and for No. 3, 4·71.

All three were found to consist simply of sulphur and iron, the percentage of sulphur being—

In No. 1.	28·24
,, No. 2.	30·38
,, No. 3.	38·10

Hence the composition of the three layers may be represented as:—

	No. 1.	No. 2.	No. 3.		
Iron monosulphide ..	77·64	83·53	44·90		89·80
Iron	22·36	16·47	—	or	—
Iron $\frac{7}{8}$-sulphide	—	—	55·10		—
Iron disulphide	—	—	—		10·20
	100·00	100·00	100·00		100·00

The surplus metallic iron in Nos. 1 and 2 had undergone absorption by the sulphide, and was uniformly distributed through it, perhaps as Fe_2S or Fe_8S; no separate grains or particles of iron could be detected. The carbon of the iron seemed to have been completely removed.

(To be continued).

NOTICES OF BOOKS.

Lecture on Water. Delivered before the American Institute of the City of New York, in the Academy of Music, January 20th, 1871. By C. F. Chandler, Ph.D., Professor of Analytical and Applied Chemistry, School of Mines, Columbia College; Chemist to the Health Department of the City of New York. Albany: The Argus Company. 1871.

Dr. Chandler treats his subject in detail; and the lecture does not take that stereotyped form too common in scientific addresses. The lecture opens with a short account of the estimation in which water was held in earlier ages. We are told that the Hindoos and the Egyptians considered water the element from which all other bodies

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* *Ann. d. Chem. u. Pharm.*, clix., 341.

were formed. In later times, the idea was maintained that repeated evaporation converted water into earth. Lavoisier, in 1770, tested experimentally the question of the conversion of water into earth. It had long been known that when water was placed in a glass retort or alembic, and distilled, there remained behind a small quantity of earthy matter; and if the water was returned to the alembic, and distilled again, the quantity of earthy matter increased, and continued to increase as often as the water was distilled from it. It was supposed, therefore, that the water was gradually converted into earth. Lavoisier distilled three pounds of water again and again, in an alembic provided with a condenser, the whole apparatus being hermetically sealed, that not a particle of water should be lost. At the close of the experiment, he found that while the quantity of water had not diminished in the least, he had a residue of 20 grs. of earthy matter in the alembic. As the water had not diminished, he justly concluded that it had not come from the water; it must have been derived from the alembic itself. On cleansing the alembic and condenser, and weighing them, it was found that they had lost 17 grs. 17 grs. of the earthy matter had, therefore, been produced by the action of the boiling water on the glass. The remaining 4 grs. were attributed by Lavoisier to the natural impurities of the water. Scheele tested the same question, and not only proved that the earthy matter was derived from the glass, but analysed it, and found it to consist of the same constituents, potash, lime, and silica. Dalberg repeated the experiment in a silver vessel, and obtained no earthy matter. So the conversion of water into earth was proved to be a fallacy due to the action of the water upon the glass vessel.

Dr. Chandler incidentally shows that progress in chemistry has been chiefly within the last hundred years, or, rather, until that time but few correct ideas of the composition of ordinary substances were entertained; and he then passes on to consider the sources of water for domestic and for manufacturing purposes. Rivers, of course, are more likely to be charged with *suspended* impurities, for the reason that their waters, which have not been filtered through the soil, carry with them a certain quantity of clay and organic matter. The water of the Mississipi contains 40 grs. of mud per gallon; and it is estimated that this river carries 400,000,000 tons of sediment per annum into the Gulf of Mexico. The Ganges is said to carry down 6,368,000,000 cubic feet annually. This transportation of mud in suspension has produced large deposits at the mouths of these rivers. All of the State of Louisiana, and considerable portions of other States which border upon the lower Mississipi have been formed by the deposition of these sediments brought from higher levels.

Speaking of medicinal springs, Dr. Chandler gives an analysis of Congress Spring water, made in his own laboratory, with the assistance of Mr. F. A. Cairns, M.A.:—

"One United States gallon of 231 cubic inches contains:

Chloride of sodium	400·444 grs.
Chloride of potassium	8·049 ,,
Bicarbonate of magnesia ..	121·757 ,,
Bicarbonate of lime	143·399 ,,
Bicarbonate of lithia	4·761 ,,
Bicarbonate of soda	10·775 ,,
Bicarbonate of baryta	0·928 ,,
Bicarbonate of iron	0·340 ,,
Bicarbonate of strontia	a trace.
Bromide of sodium	8·559 ,,
Iodide of sodium	0·138 ,,
Sulphate of potassa	0·889 ,,
Phosphate of soda	0·016 ,,
Silica	0·840 ,,
Fluoride of calcium, Biborate of soda, Alumina }	each a trace.
Total	700·895 grs.
Carbonic acid gas ..	392·289 cubic inches.

"A comparison of the above with the analysis made by Dr. John H. Steel, in 1832, proves that the Congress water still retains its original strength, and all the virtues which established its well-merited reputation.

"Its superior excellence is due to the fact that it contains, in the most desirable proportions, those substances which produce its agreeable flavour and satisfactory medical effects—neither holding them in excess, nor lacking any constituent to be desired in this class of waters.

"As a cathartic water its almost entire freedom from iron specially recommends it, many of the other springs contain so much of this ingredient as to seriously impair their usefulness."

Among medicinal springs are the sulphur waters of the White, Red, and Salt Sulphur Springs of Virginia, the White Sulphur Springs of Ohio, and the Richfield, Sharon, Chittewango, and Florida Springs of New York State, corresponding to the waters of Harrogate, Croft, and Aix-la-Chapelle. The sulphuretted hydrogen gives these waters a sweet taste and a very peculiar odour, which some consider offensive. These waters have, on analysis, yielded the following results:—

*Analyses of Sulphur Waters.**

In one U. S. Gallon of 231 cubic inches.	Chittenango, Madison Co., N. Y.			Florida, Montgomery Co., N.Y.
	White Sulphur spring.	Cave spring.	Magnesia spring.	Florida spring.
	Grs.	Grs.	Grs.	Grs.
Hydrosulphate of sodium (NaS,HS)	0·117	0·386	0·757	2·00800
Hydrosulphate of calcium (CaS,HS)	—	1·123	0·929	—
Sulphate of potassa	—	—	—	1·39000
Sulphate of soda	0·213	—	—	—
Sulphate of lime	81·420	106·126	115·085	—
Sulphate of strontia	trace	trace	trace	—
Sulphate of magnesia	1·953	7·589	12·718	—
Hyposulphite of soda	—	0·257	0·020	0·71100
Bicarbonate of soda ($NaO,HO,2CO_2$)	—	—	—	22·14300
Bicarbonate of lime	—	—	—	8·31700
Bicarbonate of magnesia	22·017	23·973	20·779	6·97200
Bicarbonate of iron	0·078	0·156	0·325	—
Chloride of potassium	0·156	0·233	0·333	—
Chloride of sodium	1·037	1·569	1·833	5·88000
Chloride of lithium	trace	trace	trace	—
Alumina	0·082	0·222	trace	trace
Silica	0·286	0·519	0·577	0·79300
Sulphur (in suspension)	trace	—	—	—
Sulphide of iron (in suspension) ..	—	—	—	0·17600
Total solid contents per gallon ..	107·359	142·113	153·356	43·39000
Total sulphur in the metallic sulphides and sulphuretted hydrogen.	0·339	1·397	2·400	1·91654
Cubic Inches of Gas per Gallon.				
Sulphuretted hydrogen gas	0·884	2·754	5·623	3·76500
Carbonic acid gas	20·480	15·934	19·436	32·16900

With the exception of the hydrosulphate of sodium, hydrosulphate of calcium, hyposulphite of soda, sulphur, sulphide of iron, and sulphuretted hydrogen gas, the substances found in these waters are not essentially different from those contained in most spring waters; while to the sulphuretted hydrogen the peculiar odour is due, and to the action of the oxygen of the air on this gas the white milky turbidity arising from the freed sulphur.

Among the many curious springs occurring in Saratoga county is the High Rock spring. The Indian name *Saraghtoga* means *the place of salt*, and it was to the High Rock spring that the Indians, in 1767, bore Sir William Johnson. The spring rises on a little mound of stone, three or four feet high, which appears like a miniature volcano, except that sparkling water instead of melted lava flows from its little crater. Until quite recently, the water did not overflow the mound, but came to within a few inches of the summit, some other hidden outlet permitting it to escape. A few years ago, the property changed hands, and the new owners, convinced that by stopping the lateral outlet they could cause the water

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* Made by Dr. Chandler, with the assistance of W. H. Chandler and F. A. Cairns, A.M.

again to issue from the mouth of the rock, employed a number of men to undermine the mound, and with a powerful hoisting derrick to lift it off, and set it one side, that the spring might be explored. Just below the mound were found four logs, two of which rested upon the other two at right angles, forming a curb. Under the logs were bundles of twigs resting upon the dark brown or black soil of a previous swamp. Evidently some ancient seekers after health had found the spring in the swamp, and, to make it more convenient to secure the water, had piled brush around it, and then laid down the logs as a curb. The rock was formed by the water. It is composed of tufa, carbonate of lime, in the same manner as stalactites and stalagmites. As the water flowed over the logs, the evaporation of a portion of the carbonic acid caused the separation of an equivalent quantity of insoluble carbonate of lime, which layer by layer built up the mound. A fragment of the rock yielded, on analysis :—

Carbonate of lime	95·17
Carbonate of magnesia	2·49
Sesquioxide of iron	0·07
Alumina	0·22
Sand and clay	0·09
Organic matter	1·11
Moisture	0·39
Undetermined	0·46
	100·00

"Below the rocks," continues Dr. Chandler, "the workmen followed the spring through 4 feet of tufa and muck. Then they came to a layer of solid tufa 2 feet thick, then 1 foot of muck, in which they found another log. Below this there were 3 feet of tufa; and there, 17 feet below the apex of the mound, they found the embers and charcoal of an ancient fire. By whom and when could the fire have been built? The Indian tradition went back only to the time when the water overflowed the rock; how many centuries may have elapsed since even the logs were placed in position? Calculations have been made by counting the layers of tufa, eighty-one being found to the inch, and the time since the fire was built has been fixed at 5,870 years; but, as I have seen half an inch of tufa formed in two years on a brick which received the overflow from a spout containing only 20 grains of carbonate of lime in a gallon, I am inclined to think our antiquarian's estimates are not entirely reliable."

After treating of chalybeates, acid, alum, borax, and siliceous waters, the lecturer proceeds to the discussion of the water supply for manufacturing purposes. He here embodies the results of numerous analyses of boiler incrustations in a table too copious for extraction. The removal of impurities by boiling, distillation, filtering, treatment with charcoal, permanganate of potash, &c., is next considered; but we must pass on to the simple statement of the characteristics of a good drinking water, which may be thus enumerated. The temperature should be at least 10° lower than the temperature of the atmosphere, but it should not be much lower than 45° F. It should be free from taste, smell, and of course should be transparent. "With regard," says the lecturer, "to the total quantity of impurities admissible in good drinking water, the sanitary congress which met at Brussels decided that water containing more than 35 grains of impurity in 1 gallon is not wholesome, and that there should not be much more than 1 grain of organic matter. Thirty-five grains is a large quantity for city water, though drainage-wells frequently contain more. The quality of the impurities is more important than the quantity. It is found that 5 or 6 grains of lime or magnesia render water unfit for the cooking of leguminous vegetables. On the other hand, it is a great advantage in making tea or coffee to use water of about 5° of hardness; that is, containing about 5 grains of carbonate of lime or its equivalent in the gallon. A person of very nice taste can tell the difference in tea or coffee made with water in which the difference is not more than 2 or 3 grains of lime or magnesia to the gallon. It is on this account that certain wells have a great reputation as 'tea wells.' In olden times there were two or three such wells in New York, and a boy was kept by the corporation to pump water for the benefit of the natives. The fine flavour of the tea made with such water is due to the fact that the 5 or 6 grs. of carbonate of lime prevent the water from dissolving the astringent matter contained in the tea, without interfering with the extraction of the theine and the other desirable constituents of the leaf. Magnesia in large quantities is objectionable, as are also lime salts; they are liable to cause dyspepsia. It is said that horses acquire a rough coat if supplied with water containing a large quantity of sulphate of lime. Goitre and cretinism are attributed to these impurities in the water. It is a curious fact that in Ireland, on the Waterford side of the Suir, where sandstones and slates prevail, goitre and cretinism are almost unknown; while on the Kilkenny side, where limestones abound, goitre is not uncommon. Perhaps the idiotic behaviour of those famous Kilkenny cats is attributable to the calcareous impurities of the water with which these unfortunate quadrupeds slaked their thirst."

Dr. Chandler has given much attention to the metallic impregnations of drinking waters. The most formidable is lead, from the action of the water on the lead pipes. Recently, the attention of the (New York) Metropolitan Board of Health having been called to the frequent cases of chronic lead poisoning which occurred in the city, Dr. Chandler was requested to investigate both the Croton water, and the various hair tonics, invigorators, and washes in common use, with a view to discovering the probable cause of the poisoning. The following contained grains of lead in one fluid ounce :—

Clark's Distilled Restorative for the Hair	0·11
Circassian Hair Rejuvenator	2·71
Professor Wood's Hair Restorative	3·08
Gray's Celebrated Hair Restorative	3·39
Phalon's Vitalia	4·69
Mrs. S. A. Allen's World's Hair Restorer..	5·57
Singer's Hair Restorative	16·39

Examinations were also made of Croton water which had been in contact with lead for different lengths of time, under usually occurring circumstances, of which the following are the results :—

(1). A gallon of Croton water from a lead-lined cistern, in which it had stood several weeks, was found to contain 0·06 grain of metallic lead.

(2). A gallon of water which had remained six hours in the lead pipes of a residence yielded 0·11 grain of metallic lead, a considerable portion of which was visible to the eye, in the form of minute white spangles of the hydrated oxycarbonate $(\mathrm{PbO,HO+PbO,CO_2})$.

(3). Water drawn from one of the hydrants of the School of Mines' laboratory in the middle of the day, when the water was in constant motion, yielded traces of lead. This water reaches the school through about 100 to 150 feet of lead-pipe.

Certainly no pains should be spared to impress upon servants the importance of allowing the water to run for a few minutes before taking it for drinking or cooking purposes, especially early in the morning, after the water has stood all night in the pipes. The habit of filling the tea-kettle from the boiler, or of using water from the boiler for any purpose except washing, is very dangerous.

Few cities are more fortunate in the quantity and quality of their water supply than are New York and Brooklyn. The Croton water is brought to the city of New York by an aqueduct 45 miles long. Where the water enters the aqueduct a dam, 230 feet wide and 45 feet high, was erected in the Croton River, by which the Croton Lake was formed. This serves as a great reservoir, or sedimentary basin. The purity of the Croton water is remarkable; the following table shows the quantities of different substances obtained from one United States' gallon of 231 cubic inches:—

	Grains.
Soda	0·326
Potassa	0·097
Lime	0·988
Magnesia	0·524
Chlorine	0·243
Sulphuric acid	0·322
Silica	0·621
Alumina and oxide of iron	trace
Carbonic acid (calculated)	2·604
Water in bicarbonates (calculated)	0·532
Organic and volatile matter	0·670
Total	6·927
Less oxygen, equivalent to the chlorine	0·054
	6·873

These acids and bases are probably combined in the water as follows:—

Chloride of sodium	0·402
Sulphate of potassa	0·179
Sulphate of soda	0·260
Sulphate of lime	0·158
Bicarbonate of lime ($CaO,HO,2CO_2$)	2·670
Bicarbonate of magnesia ($MgO,HO,2CO_2$)	1·913
Silica	0·621
Alumina and oxide of iron	trace
Organic matter	0·670
Total	6·873

On evaporating a gallon of this water a residue of only 4·78 grains is obtained, the bicarbonates of lime and magnesia being left as simple carbonates.

The following tabular statement shows how favourably the Croton compares with the waters supplied to other cities:—

Impurities contained in One Gallon of 231 cubic inches, expressed in grains.

City.	Source.	Inorganic Matter.	Organic and Volatile Matter.	Total Solids.
New York	Croton, average for 13 weeks, 1867 (C. F. Chandler)	3·90	0·66	4·56
New York	Croton, average for 3 months, 1868 (C. F. Chandler)	3·31	1·14	4·45
New York	Croton, average for 6 months, 1869 (C. F. Chandler)	4·11	0·67	4·78
New York	Well west of Central Park (C. F. Chandler)	38·95	4·55	43·50
Philadelphia	Delaware (H. Wurtz)	2·93	0·55	3·48
London	Thames (Dr. H. Letheby)	15·55	0 83	16·38
London	Well, Leadenhall Street (Dr. H. Letheby	90·38	9·59	99·97
Dublin	Lough Vartry, new supply (Apjohn and others)	1·77	1·34	3·11
Paris	Seine, above the City (Bussey, Wurtz, and Ville	7·83	1·00	8·83
Amsterdam	River Vecht (V. Baumhauer and V. Moorsel	14·45	2·13	16·58
Amsterdam	Deep well at the Keisersgracht	64·55	4·38	68·93

CORRESPONDENCE.

THE ATOMIC THEORY.

To the Editor of the Chemical News.

Sir,—We have heard much of late respecting the uselessness to the chemist of Dalton's theory. No believer in progression considers that the conception it affords of the constitution of matter is an absolutely true one. For upwards of half a century the theory has done incalculable service to chemistry, and remains still the guiding-star of that science. si Every worker would hail with joy an attack on this mple but noble creation of a great mind, were the assailants armed with that resistless weapon—*experiment.* Phlogiston fell, as other theories have fallen, not by words, but by the sheer power of experiment. The anti-atomists should, therefore, follow the example set by Lavoisier, and attack what they consider so useless for mentally connecting experimental facts, and so injurious to scientific thought and progress, by the only means that can avail.—I am, &c.,

Alfred Tribe.

May 27, 1872.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 22, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Method of Quantitatively Estimating Copper by means of Solution of Cyanide of Potassium.—De Lafollye.—Reserved for full translation.

Action of Sulphuric Ether on Iodides.—E. Ferrière.—When to a solution of any iodide in water there is first added some starch solution, and this mixture shaken up with sulphuric ether, the following phenomena are observed:—If the solution of the iodide is somewhat concentrated, a portion of iodine is set free, and the starch is coloured blue; if the solution is weak, this colouration only sets in after some three hours; if the solution is very dilute, the blue colouration only appears after some two or three days. When the blue-coloured starch is separated by filtration, and there is added to the filtrate another dose of ether, the blue colouration again appears, all the iodine being at last driven from its combination; chlorides and bromides are not thus acted upon. The author attributes this decomposition to the slow but continuous formation of an unstable iodhydric ether, (C_4H_5I), but the experimental proof of that reaction has not been found by him.

Synthesis of Orcin.—G. Vogt and A. Henniger.—By heating chlorated toluen, C_7H_7Cl, upon a water-bath, there are obtained two chloro-cresyl-sulphurous acids, $C_7H_6(Cl,SO_3H)$, which are converted into two isomeric acid baryta salts—

α-chloro-cresyl-sulphite of baryta, $(C_7H_6ClSO_3)Ba+2H_2O$.
β-chloro-cresyl-sulphite of baryta, $(C_7H_6ClSO_3)Ba+1\frac{1}{2}H_2O$.

The first-named of these salts, which is soluble in cold water, crystal line, and also soluble in boiling alcohol, yields orcin when fused with caustic potassa, although it might have been supposed that a diphenol of the formula—

$$C_7H_6\left\{\begin{matrix}OH\\OH\end{matrix}\right.$$

This reaction is elucidated by the following formula:—

$$^{*}\ C_7H_6\left\{\begin{matrix}Cl\\SO_3K\end{matrix}\right.+2KHO=C_7H_6\left\{\begin{matrix}OH\\OH\end{matrix}\right.+KCl+SO\left\{\begin{matrix}OK\\OK\end{matrix}\right.$$

The orcin thus synthetically formed is in all respects identical with that obtained from lichens, but the process of preparing it is not industrially applicable.

Researches on the Physiological Action of the Different Opium Alkaloids.—Dr. Rabuteau.—This lengthy memoir contains the results of some very important experiments, made with the view to elucidate the action of the different opium alkaloids upon the human system.

This number also contains a series of important papers relating to astronomy, meteorology, geology, and zoology.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 7, 1872.

This number contains the following original papers and memoirs:—

Specific Heat of Carbon.—H. F. Weber.—Notwithstanding the high scientific value of this exhaustive memoir, its contents are not well suited for abstraction.

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[*] This salt is formed from the baryta salt by double decomposition with sulphate of potassa.

Behaviour of the so-called Sulphuric Acid Chamber Crystals towards Water.—C. Rammelsberg.—In the introduction to this lengthy memoir, the author first reviews the conditions of the formation of the compound alluded to, which may be formed (1) by the action of sulphuric acid upon nitrous acid; (2) by the action of sulphuric acid on dioxide of nitrogen (so-called hyponitric acid); (3) by the action of sulphurous acid upon dioxide of nitrogen in the presence of too small a quantity of water. This latter is the mode of formation in the sulphuric acid chambers if sufficient water (steam) is not present. The author then quotes the results of the analysis of the crystals as found by Clément and Desormes, Gaultier de Claubry, Weber, Weltzien, and others. The formula of the lead chamber crystals is—

$$\left\{\begin{array}{l}\left.\begin{array}{r}H_2\\ SO_2\end{array}\right\}O_2\\ \left.\begin{array}{r}N_2O_2\\ SO_2\end{array}\right\}O_2\end{array}\right\}$$

In the continuation of this memoir, the author treats at great length on the action of water upon the body just alluded to; it appears that in 100 parts of the crystals there are contained 6·38 per cent of $N_2O_5 =$ N, 1·65, and 20·47 per cent $N_2O_3 =$ N, 7·54; N = 9·19 per cent; to this quantity of N has to be added 2·57 N which are set free in the shape of NO, bringing the total amount of N up to 11·76 per cent. By becoming decomposed by water, the chamber crystals yield 22 per cent of oxide of nitrogen, 14 per cent of nitric acid, and 64 per cent of nitrous acid.

Estimation of Uric Acid.—H. Schwanert.—The main gist of this physiologico-chemical paper is that hydrochloric acid fails to precipitate uric acid from urine completely, so that, upon 100 c.c. of fluid (urine) treated with hydrochloric acid, a quantity of 0·0048 grm. of uric acid remains in solution, and has, of course, to be added to the quantity of uric acid found.

Short Communication on Naphthalin - Carboxyl - Acid - Amide.—P. v. Rakowski.—The author states that, while preparing naphtoë acid according to Merz's method, by boiling naphthalin-cyan with alcoholic potassa solution, he obtained, by exhausting the residue with water, a compound (not naphthalin, as stated by Merz) which, on being submitted to elementary analysis, led to the formula $C_{11}H_9NO$ —that is to say, naphthalin-carboxyl-acid-amide; constitutional formula, $C_{10}H_7CONH_2$.

Silico-Heptyl Series.—A. Ladenburg.—The continuation of a lengthy monograph on this subject.

Constitution of Benzol.—A. Ladenburg.—The contents of this paper are, notwithstanding the intrinsic merits, not well suited for useful abstraction.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 232, April, 1872.

This number does not contain any original papers relating to chemistry.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, March 14, 1872.

Alloy which may serve to Unite Iron or Steel to Brass.—C. Mène.—The alloy consists of 3 parts of tin, 39·5 of copper, and 7·5 of zinc, which latter, since some of it is volatilised by the smelting together of the metals, may be increased to 10 parts; this alloy may serve to unite (solder together) copper or brass to iron or steel.

Les Mondes, April 25, 1872.

Bibliography.—Under this heading we quote the titles of the following works, which are highly spoken of in the above-quoted periodical:—"Histoire de l'Economie Politique des Anciens Peuples de l'Inde, de l'Egypte, de la Judée, et de la Grèce," par M. du Mesnil-Marigny; 2 vols.; Paris: H. Plon, 1872. "Cours Elémentaire de Géologie Appliquée, Lithologie Pratique ou Etude Génerale et Particulière des Roches," par M. Stanislas Meunier; Paris: Dunod, 1872.

General Theory of Chemical Action.—Dr. E. J. Maumené.—The first instalment of a series of papers on this subject, elucidated by woodcuts and a series of algebraical formulæ.

Annalen der Chemie und Pharmacie, May, 1872.

This number contains the following original memoirs and papers:—

Butyric Acids of various Origin.—C. Grünsweig.—This very lengthy monograph contains the following sections:—Introduction, a concisely written and complete review of all that has been done by different authors in this direction; normal butyric acid; oxidation of normal butyric acid; salts of the normal butyric acid, viz., of silver, calcium, strontium, and zinc; normal butyric acid isobutylester (*Isobutylester*); isobutyric acid; oxidation of isobutyric acid; salts of this acid, viz., of silver, calcium, strontium, and zinc; isobutyric acid isobutylester; butyric acid from butter; butyric acid from coniine; butyric acid from St. John's bread, carob-tree (*Ceratonia siliqua*).

Pollen, and on the Formation of Wax.—W. von Schneider.—The first instalment of an exhaustive monograph, the contents of which are, notwithstanding their high scientific value, not suited for abstraction.

Studies on the Combinations of the Camphor Group.—J. Kachler.—The second instalment of a lengthy monograph on this subject divided into the following sections:—Campholic acid, $C_{10}H_{18}O_2$; salts of this acid, viz., of potassa, soda, ammonia, lime, baryta, magnesia, zinc, copper, silver; campholic acid and bromine; campholic acid and phosphorchloride; dry distillation of the salts of campholic acid; campinic acid.

Azo Compounds of Resorcine.—P. Weselsky.—This memoir, elucidated by a large number of complex and lengthy formulæ, is divided into the following chapters:—Introduction; diazo-resorufin; hydrochlorate of hydro-diazo-resorufin; resorcin-tetra-azo compounds; nitrate of tetra-azo-resorufin; nitrate of dihydro-tetra-azo-resorcin; hydrochlorate of hydro-amido-tetra-azo-resorufin; hydro-imido-tetra-azo-resorufin; diazo-resorcin and acetyl-chloride.

On Dextronic Acid.—J. Habermann.—The acid just named is formed from dextrine, in the same manner as lactonic acid is formed from sugar of milk, viz., by heating in a water-bath a mixture of 50 grms. of dextrine, 300 c.c., and 40 grms. of bromine, the mixture being poured into strongly-made bottles,—champagne wine bottles answer the purpose best,—the fluid is first treated with oxide of silver, next with hydro-sulphuric acid, and the free dextronic acid then converted into a lime, and afterwards into a lead salt, from which at last the acid is set free; the free acid is very similar to gluconic acid, but exhibits a slight difference from the latter as regards its behaviour in the polarisation apparatus; dextronate of lime, $C_6H_{11}CaO_7+\frac{1}{2}H_2O$, contains water of crystallisation driven off at 120°.

Products of Distillation of Sugar mixed with Lime.—R. Benedikt.—This paper treats on the substances obtained by the dry distillation of a mixture of lime and sugar (3 parts of lime to 1 of sugar). The author states that metaceton and isophoron are the chief fluid products of this operation, but a large quantity of gases are simultaneously formed.

Some of the Products of the Condensation of Aldehyde.—A. Kekulé.—The fourth portion of this monograph, treating on the condensation of aldehyde with the taking up (*Aufnahme*) of hydrogen.

On Rufiopine.—C. Liebermann and C. Chojnacki.—After first referring at some length to the researches of Anderson, Matthiessen, Foster, and others on this subject, the authors treat on the preparation of rufiopine, a colouring matter, $C_{14}H_8O_6$, which they state to be very closely allied to the madder pigments; while, moreover, rufiopine, treated with zinc dust, yields anthracen. The close alliance between rufiopine and the anthracen pigments is elucidated in the following manner:—$C_{14}H_8O_3$, monoxy-anthrachinon; $C_{14}H_8O_4$. alizarine; $C_{14}H_8O_5$, purpurine; $C_{14}H_8O_6$, rufiopine (pseudopurpurine?); $C_{14}H_8O_8$, rufigallic acid.

On Naphthazarine.—C. Liebermann.—Notwithstanding the high scientific value of this memoir, its contents are not well suited for any useful abstraction, an observation also bearing upon the following memoir:—

Aromatic Glycolic Acid.—W. Dittmar and A. Kekulé.

Some Combinations of Tungsten (Wolfram).—Dr. H. E. Roscoe.—This essay is divided into the following sections:—Preparation of metallic tungsten; chlorides of tungsten—viz., hexachloride, pentachloride, tetrachloride, dichloride; oxychlorides; bromides; reduction of the pentabromide in hydrogen; oxybromides—viz., monoxybromide, dioxybromide; iodide; atomic weight of tungsten—(*a*) by reduction of the trioxide, (*b*) by analysis of the hexachloride.

Salt (Chloride of Sodium) contained in the Extract of Meat.—Dr. J. Baron von Liebig.—The eminent *savant* has written this paper with the view to refute the allegation made by a Dr. Godefroy, who appears to have published, in an Austrian scientific paper, a statement to the effect that Liebig's extract of meat should contain 2 per cent of chloride of sodium, purposely added as a fraud. The author refers Dr. G. to his (Liebig's) essays published in this periodical some twenty years ago, "On the Constituents of the Fluids contained in Meat," and emphatically denies that at Fra Bentos, where the extract of meat is made, any common salt is added to it. Chloride of potassium is largely contained in the extract.

Oxygen-Containing Ethyl Compounds.—E. Erlenmeyer.—This essay is divided into the following chapters:—Experiments on the formation of alcohol from ether, and of ether from alcohol, under the influence of dilute sulphuric acid and a higher temperature; formation of ether from alcohol under the influence of sulphuric acid, ethyl-ester (*äthylester*) and ethyl-sulphuric acid; sulphuric acid ethylester; alcohol and ethyl-sulphuric acid; on Gerhardt's parathionic acid.

Dicyanacetic Acid.—D. Amato.—This paper treats at length on the results of a series of experiments made with the view of trying to bind three carboxyles (CO.OH) to the same carbon atom. The author describes, however, mainly the action of cyanide of potassium upon dichloracetic ether.

La Revue Scientifique de la France et de l'Etranger, April 27, 1872.

This number does not contain any original papers on chemistry, but we quote the titles of the following interesting papers:—

The Resources, Soil, Climate, Population, Agriculture, Industry, and Commerce of the Alsace.—Ch. Grad.

Continuation of the Lectures on Animal Heat; Temperature of Arterial and Venous Blood.—C. Bernard.—Illustrated by woodcuts.

NOTES AND QUERIES.

Waste of Sulphur in the Cornish Tin Mines.—The writers of letters to Dr. Tayler with reference to the article as above, which appeared in last week's number, will oblige by sending their addresses, as their letters have been lost in forwarding to the post.—W. H. Tayler, M.D., Tudor House, Anerley, Surrey.

Chinese Cement.—Some time since there appeared a notice of a Chinese Cement (Schio Liao), consisting of 3 parts of blood and 4 of lime, with a little alum. I have tried it, but not with the success I expected. I have used sheep's blood. Finding in Cooley's "Receipts" what is called "coppersmith's cement," made from bullock's blood and lime, I shall be glad if any of your readers can suggest any difference between the two which would be likely to alter the cement.—C. E.

MEETINGS FOR THE WEEK.

Monday, June 3rd.—Royal Institution, 3. General Monthly Meeting.
—— London Institution, 4. Prof. Bentley, F.L.S., "On Elementary Botany."
Tuesday, 4th.—Royal Institution, 3. E. B. Tylor, F.R.S., "On the Development of Belief and Custom amongst the Lower Races of Mankind."
—— Zoological, 9.
Wednesday, 5th.—Microscopical, 8.
—— Geological, 8.
Thursday, 6th.—Royal Society Club, 6.
—— Royal Institution, 3. Prof. Tyndall, LL.D., F.R.S., "On Heat and Light."
Friday, 7th.—Royal Institution, 9. Dr. Odling, F.R.S., "On the History of Ozone."
—— Geologists' Association, 8.
Saturday, 8th.—Royal Institution, 3. Prof. Roscoe, F.R.S., "On the Chemical Action of Light."

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THE CHEMICAL NEWS.

Vol. XXV. No. 654.

ON A
DOUBLE SULPHIDE OF GOLD AND SILVER.*

By M. M. PATTISON MUIR, F.C.S.

About eight months ago, at the Thames Goldfield, New Zealand, my brother, Mr. John M. Muir, in conjunction with Mr. William Carrick, made some experiments upon the action of sulphur on a molten mixture of gold and silver, with the view of applying the reaction to the separation of these metals on the large scale. These experiments resulted, however, somewhat otherwise from what they had expected; instead of a complete separation of gold and silver being effected by means of the formation of a sulphide of silver, they found what seemed a new compound produced. A sample of this substance they sent to me, an analysis of which I hope will not prove wholly uninteresting.

Before proceeding to the actual analysis of the substance, I shall briefly state the general method employed by my brother and Mr. Carrick when studying the action of sulphur on gold and silver. The crude gold containing silver was placed in a large pot upon the furnace, where it stood until the contents were molten. Into an iron mercury-bottle turned upside down, by means of a screw-tap, was poured a quantity of sulphur; fitted to the other, that is, the downward end of the bottle, was a plumbago pipe. The sulphur in the bottle, by means of a furnace-fire, was now rendered liquid, and the bottle swung over the pot containing the molten gold and silver. The lower end of the plumbago pipe having been inserted beneath the surface of the molten mixture, the sulphur was allowed to flow down the pipe, and bubble through the contents of the pot. Before doing this, however, a thin film of borax was spread over the molten gold and silver. Quantities of Thames gold, varying from 20 ozs. to 160 ozs., were then treated, the operation being continued from ten minutes to an hour.

At the end of this treatment with sulphur, the pot was taken off the fire, and the gold allowed to solidify, the liquid borax and what they supposed to be sulphide of silver being then poured off. The borax was easily broken off after cooling, and the sulphide obtained as a cake. It was invariably, in all the experiments which my brother and Mr. Carrick conducted, found that the assay of the gold rose from 654 to 812, but there remained stationary, showing that by no means all the silver was extracted. The substance which they supposed to be a double sulphide of gold and silver,—and this supposition, has, I think, been confirmed by analysis,—is a dark grey, hard solid, very much resembling many specimens of native Sb sulphide. It has a crystalline structure, can be cut by a knife, but is very brittle, and has a specific gravity of 8·159. By heating in a current of air, it remains undecomposed. But, by fusion with Na_2CO_3, a sulphide of Na is formed, and a second alloy of gold and silver remain. After protracted boiling in strong HNO_3, almost all the silver is dissolved, leaving nearly pure metallic gold. I found that by gentle heating with strong H_2SO_4 for a long time, and subsequent treatment with hot water, it is possible to obtain all the silver in solution, the gold being left behind as a finely divided powder.

1·1915 grms. thus treated gave 0·4252 grms. of gold = 35·569 per cent. The filtrate, precipitated with HCl, gave 0·7799 grms. AgCl = 0·5870 Ag = 49·27 per cent. Another portion, weighing 0·5475 grm., heated gently with strong HCl and $HClO_3$, gave in the solution a precipitate of $BaSO_4$ = 0·6414 = S, 0·0885 = 16·17 per cent.

From the results of my analysis, I have deduced the formula for the substance of $2(Au_2S_3)5(Ag_2S)$.

The percentage amounts required by this formula, together with those actually obtained, are given below:—

	Calculated.	Found.
Sulphur	15·87	16·17
Gold	35·47	35·69
Silver	48·66	49·27
	100·00	101·13

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* Read before the Glasgow Philosophical Society, April 29, 1872.

ANALYSIS OF SOME CRYSTALS DEPOSITED
UPON THE
ZINC OF A LECLANCHE BATTERY.

By GEORGE E. DAVIS.

In the month of July, 1871, I put up an electric bell at my residence, which was worked by two cells of a Leclanché battery. These cells were of the Bunsen form,—zinc cylinders, with a carbon block in a porous pot. The carbon block was packed into the porous pot, with a mixture of pounded gas-carbon and manganese dioxide, to within half an inch of the top, and the pot was then filled to the top with melted resin, to which bees'-wax had been added to prevent cracking. All the dust was carefully sifted from the carbon-manganese mixture, that used resembling a very coarse gunpowder, and the solution used was a saturated one of ammonium chloride. At the end of February, 1872, the battery began to exhibit signs of exhaustion, and ultimately, early in March, refused to act altogether, except when the circuit was kept closed for a long period of seconds. I may as well add that evaporation was compensated for by the periodical addition of distilled water, nothing else being added to the battery.

On taking the battery to pieces, for the purpose of cleaning it, the porous pot was found to be encrusted with a white insoluble powder: the zinc cylinder was also encrusted, but to a less extent, and from it grew seven or eight opaque white crystals, of the second system,—perfect octahedrons having square bases: they were washed with distilled water, and dried over sulphuric acid.

A qualitative analysis showed me zinc oxide, chlorine, and ammonia, so the quantitative was an easy operation. Only the zinc oxide and the chlorine were determined, as they were deemed sufficient to elucidate the composition of the crystals.

a. 0·91 grm. of the crystals gave 0·48 grm. of ZnO, or 52·74 per cent.

β. 0·7 grm. of the crystals gave 0·37 grm. of ZnO, or 52·85 per cent.

γ. 0·58 grm. gave 0·55 grm. of AgCl, or 23·44 per cent of chlorine.

These numbers obtained agree closely with the formula $ZnH_2O_2NH_4Cl$, thus:—

	Calculated.		Found.	
ZnO	81·0	53·11	52·74	52·85
H_2O	18·0	23·62	—	—
NH_4	18·0		—	—
Cl	35·5	23·27	23·44	—
	152·5	100·00		

Cold water dissolved but little of the ammonium chloride out of the powdered crystals, but when *boiled* with a large quantity of water the salt is decomposed, ammonium chloride dissolving, and leaving behind the zinc hydrate.

Radcliffe, May 29, 1872.

ON THE LAST NEW METAL, INDIUM.*

By WILLIAM ODLING, M.B., F.R.S.,
Fullerian Professor of Chemistry, R.I.

(Concluded from page 254).

The chief point of chemical interest with regard to any newly-discovered element, and consequently with regard to indium, is the establishment of its atomic weight, which, in the case of a metallic element, is based primarily upon the determination of the ratio in which it combines with oxygen and chlorine. Now the quantity of indium which unites with 8 parts by weight of oxygen and with 35·5 parts by weight of chlorine, has been found by Winkler to be 37·9, and by Bunsen to be 37·8 parts. But this determination of combining ratio falls far short of the definite establishment of the atomic weight of the metal. For example, the quantities of silver, mercury, bismuth, tin, and tantalum, which exist in the best-known chlorides of these metals combined with 35·5 parts of chlorine, are 108, 100, 70, 29, and 37 parts respectively. Nevertheless, the atomic weights of these metals are taken to be not 108, 100, 70, 29, and 37, but 108, 200, 210, 118, and 184 respectively, the chlorides of the several metals being expressed by the formulæ $AgCl_1$, $HgCl_2$, $BiCl_3$, $SnCl_4$, and $TaCl_5$, respectively. Accordingly, in order to deduce the atomic weight of indium from the ascertained composition of its chloride, we require first to know whether its chloride is a mono-, di-, tri-, tetra-, or penta-chloride. Now, in the case of a metal forming only one definite chloride, the constitution of the chloride as a mono- or poly-chloride, may frequently be determinated by a consideration of the analogies presented by the metal and its compounds to some other metal and its compounds, of which the atomic weight and molecular formulæ respectively are well established. But it is obvious that analogy can afford but little help in the case of a newly-discovered element, of which the analogies have still to be determined.

Failing analogy, a more sure guide to the establishment of the molecular formula of a metallic chloride is afforded in some instances by a determination of its vapour density, —tantamount to a determination of the quantity of chlorine by weight, contained in a given volume of the gas or vapour of the chloride experimented on. Thus, having estimated the quantity of chlorine contained in a given volume of heated muriatic acid gas, the quantities of chlorine contained in the same volume of the vapourised chlorides of mercury, bismuth, tin, and tantalum, under the same circumstances of pressure and temperature, are found to be 2, 3, 4, and 5 times as great, whence the formulæ HCl_1, $HgCl_2$, $BiCl_3$, $SnCl_4$, and $TaCl_5$, respectively. Now indium chloride being volatile at a red heat, there is no reason, save that resulting from the rarity and value of the body, why the density of its vapour should not be ascertained. As a matter of fact, however, no estimation of the vapour density of indium chloride has yet been made, and any evidence that might be deducible from it is consequently not forthcoming.

Lastly, a most important guide to the establishment of the atomic weight of a metal is the determination of its specific heat. In cooling through the same fall of temperature, different bodies, as is well known, give out exceedingly different quantities of heat. In the case of a pound of bismuth and a pound of brass, for instance, both raised to the temperature of boiling water, and then immersed in an excess of ice, the quantity of ice melted by the pound of brass in cooling down to the freezing-point, will be found to be more than three times as great as the quantity of ice melted by the pound of bismuth. Now the determination of the specific heats of most of the metals, compared with the specific heat of an equal weight of water as unity, has been made with extreme care and exactitude by Regnault; and on looking at the following list of specific heats, mostly of his determination, it is evident, almost at a glance, that the specific heats of the metallic elements are inversely as their respective atomic weights. Thus, taking the first and last elements on the list for example, it is observable that the specific heat of lithium, or 0·94, is weight for weight thirty times greater than the specific heat of bismuth, 0·03; but then the atomic weight of bismuth is thirty times greater than that of lithium. And throughout, the product of the specific heat into the atomic weight of one metal, divided by the product of the specific heat into the atomic weight of another metal, is approximatively equal to 1, as shown in the fourth column of the following table, in which the product of the specific heat into the atomic weight of silver is taken as the standard dividend. Now, only last year, concordant estimations of the specific heat of indium were made by Bunsen and a Russian chemist, Mendelejeff; the mean of Bunsen's two estimations being 0·0569, which, it will be observed, is very close to Regnault's estimations of the specific heats of silver, cadmium, and tin. Accordingly, the atomic weight of indium must approximate to the atomic weights of silver, cadmium, and tin; or, in other words, it cannot be 37·8 × 1, or 37·8 × 2, but must be 37·8 × 3 = 113·5; and the quantity of chlorine combined with this weight of indium being three times 35·5 parts, indium chloride will necessarily appear as a trichloride, and be expressed by the formula $InCl_3$. The determination of specific heats being a matter of direct experiment, with scarcely any ratiocination whatever, it seems impossible for anyone to observe the relationship subsisting between the accepted atomic weights of the metals, deduced from experiment by a highly complex train of reasoning, and their directly ascertained specific heats, without recognising that in the case of the metals, at any rate, the atomic weights of the chemist are something more than vain imaginings, but that they are beyond question the terse expression of a fundamental truth in nature.

TABLE II.—ATOMIC HEATS OF METALS.

Chlorides.	Atomic Weights.	Metals.	Specific Heats.	Atomic Heats.
$LiCl$	7	Lithium	0·9408	1·07
$NaCl$	23	Sodium	0·2934	1·09
$MgCl_2$	24	Magnesium	0·2499	0·97
$AlCl_3$	27·5	Aluminum	0·2143	0·95
KCl	39	Potassium	0·1695	1·07
$CaCl_2$	40	Calcium	0·1686	1·09
$MnCl_2$	55	Manganese	0·1217	1·08
$FeCl_2$, $FeCl_3$	56	Iron	0·1138	1·03
$NiCl_2$	59	Nickel	0·1075	1·03
$CoCl_2$	59	Cobalt	0·1067	1·02
$CuCl$, $CuCl_2$	63·5	Copper	0·0955	0·98
$ZnCl_2$	65	Zinc	0·0955	1·01
$AsCl_3$	75	Arsenic	0·0814	0·99
$MoCl_4$	96	Molybdenum	0·0722	1·12
$RuCl_3$, $RuCl_4$	104	Ruthenium	0·0611	1·03
$RoCl_3$	104	Rhodium	0·0580	0·98
$PdCl_2$	106	Palladium	0·0593	1·02
$AgCl$	108	Silver	0·0570	1·00
$CdCl_2$	112	Cadmium	0·0567	1·03
$InCl_3$	113·5	Indium	0·0569	1·05
$SnCl_2$, $SnCl_4$	118	Tin	0·0562	1·07
$SbCl_3$, $SbCl_5$	122	Antimony	0·0508	1·00
$TeCl_4$	129	Tellurium	0·0474	1·03
WCl_4, WCl_6	184	Tungsten	0·0334	1·00
$AuCl$, $AuCl_3$	196·5	Gold	0·0325	1·03
$IrCl_3$, $IrCl_4$	197	Iridium	0·0326	1·04
$PtCl_2$, $PtCl_4$	197	Platinum	0·0324	1·04
$OsCl_2$, $OsCl_4$	199	Osmium	0·0311	1·00
$HgCl$, $HgCl_2$	200	Mercury	0·0319	1·03
$TlCl$, $TlCl_3$	203	Thallium	0·0325	1·07
$PbCl_2$	207	Lead	0·0314	1·05
$BiCl_3$	210	Bismuth	0·0308	1·05

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* Read before the Royal Institution of Great Britain.

TABLE III.—ELEMENTS, IN ORDER OF ATOMIC WEIGHT.*

	1.	2.	3.	4.	5.	6.	7.	8.	Type.
I.	H 1	Li 7	Na 23	K 39	..	Rb 85	Ag 108	Cs 133	RCl
II.		G 9	Mg 24	Ca 40	*Zn* 65	Sr 87·5	Cd 112	Ba 137	RCl_2
III.		B 11	Al 27·5	..	..	X^a	In 113	X^b	RCl_3
IV.		C 12	Si 28	Ti 50	..	*Zr* 89	Sn 118	X^c	RCl_4
V.		N 14	P 31	V 51	As 75	Nb 94	Sb 122	..	RCl_5
VI.		O 16	S 32	Cr 52·5	Se 79	Mo 96	Te 129	..	RCl_6
VII.		F 19	Cl 35·5	Mn 55	Br 80	..	I 127	..	RCl_7
VIII.		...	..	Fe 56	..	Ru 104	..	..	RCl_8
				Co 59		Ro 104			
				Ni 59		Pd 106			
		Na 23	..	Cu 63·5	..	*Ag* 108			

The most important chemical characters of indium being thus established, there remains for consideration only the question of its affinities to certain of the previously-known elements. And seeing that the atomic weights of the elements range from 1, the atomic weight of hydrogen, up to 240, the atomic weight of uranium, there opens out the further question, whether the more obvious chemical properties of the different elements are seriated in any way with their atomic weights; or to put this last question in another form, whether the varied chemical properties of the elements are distributed among them haphazard, or according to some definite system of which the relationship subsisting between their several atomic weights may possibly serve as a key. Now the atomic weights, as distinguished from the combining proportions, of yttrium, erbium, cerium, lanthanum, and didymium, must be regarded for the present as quite unknown. Out of the fifty-eight elements, however, of which the atomic weights have been more or less well-determined, forty-six have their several atomic weights ranging from 1 to 137, in an almost unbroken succession. Ten of the other twelve have atomic weights ranging from 184, that of tantalum, to 210, that of bismuth; while the remaining two, namely, thorium and uranium, have the closely-approximating atomic weights 238 and 240 respectively. In the above Table, the symbols of the forty-six elements having atomic weights ranging from 1 to 137, are set down in the order of the atomic weights of the elements symbolised,—save only in the case of tellurium, of which the symbol is placed immediately above, instead of below, that of iodine, and of which the atomic weight may not improbably have been somewhat over-estimated. And violating the order of numerical seriation in this small particular only, it is remarkable with what facility the symbols of the forty-six elements may be arranged in parallel lines and columns, corresponding to a natural classification of the elements themselves into analogous groups and series. Indeed, a study of the entire number of elements at present known would seem to indicate that they are one and all associated with each other by a certain community of relationship; of which the well-known gradation and parallelism in properties and atomic weights, of the members of the alkali and earth-alkali, and of the halogen and oxygen families of elements, afford only the most prominent examples.

Taking the second line of the Table as an illustration, it is observable that the seven metals symbolised thereon are distinguished from all the others by their common property of forming one chloride only, and that a di-chloride; further, that the metals figuring in the uneven-numbered columns of this line, namely, magnesium 24, zinc 65, and cadmium 112, are permanent in the air, are volatilisable in the direct and basylous in the inverse order of their atomic weights, and are otherwise specially associated with one another; while the similarly associated metals of the alternate or even-numbered columns, namely, calcium 40, strontium 87·5, and barium 137, are quickly oxidisable in the air, are practically non-volatile, and are basylous in the direct instead of the inverse order of their atomic weights; and similarly, on the other lines of the Table, the elements symbolised are divisible into sub-groups, according to their odd and even positions respectively.

Such being the relationship of the elements placed on the same line, the relationship of those in the same column is of a different kind. Taking the third and seventh columns by way of illustration, it is observable that the closely consecutive elements in each column have closely consecutive atomic numbers; that the element on the first line forms a mono-chloride; that on the second line, a di-chloride; that on the third line, a tri-chloride; and that on the fourth line, a tetra-chloride; while those on the fifth, sixth, and seventh lines form oxides or oxychlorides, corresponding to a penta-, hexa-, and hepta-chloride respectively.

By reason of its atomic weight, 113·5, indium is observed to figure on the third line and seventh column of the above Table; but its position among the elements is better recognisable by a glance at the Table below, containing a portion only of the preceding one, supplemented by an additional column of elements of higher atomic weight than any of those included previously.

In respect of its atomic weight, then, triad indium occupies a position exactly intermediate between the positions of diad cadmium and tetrad tin, to both of which metals it presents a most marked resemblance in properties. They all three have the same extreme degree of fusibility, and much the same oxidisability and reducibility. Their sulphides are alike characterised by a yellow colour, that of cadmium, CdS, being neutral; that of tin, SnS_2, being acidulous; and that of indium, In_2S_3, being strictly intermediate.

	3.	7.	10.	Type.
I.	Na 23	Ag 108	—	RCl
II.	Mg 24	Cd 112	Hg 200	RCl_2
III.	Al 27·5	In 113·5	Tl 203	RCl_3
IV.	Si 28	Sn 118	Pb 207	RCl_4
V.	P 31	Sb 122	Bi 210	RCl_5
VI.	S 32	Te 129	—	RCl_6

Viewed in another aspect, triad indium occupies a position intermediate between the positions of its remote triad congeners, aluminium and thallium. The mean atomic weight of the three metals being 114·3, the atomic weight of indium is 113·5. The mean specific gravity of the three metals being 7·3, the specific gravity of indium is 7·4. And in respect of purely chemical habitudes, hydrated alumina and hydrated india might easily be mistaken for one another. It is interesting, moreover, to remark that the last-discovered two metals indium and thallium—discovered, it will be remembered, by the same process, that of spectrum analysis—should bear to one another much the same sort of relation that is borne to one another by the jovian and saturnine metals of the alchemical or even pre-alchemical era. Just, for example, as the unstable and least-known chloride of lead, $PbCl_4$, corresponds to the stable chloride of tin, $SnCl_4$, so does the unstable and least-known chloride of thallium, $TlCl_3$, correspond to the stable, and as yet only known, chloride of indium, $InCl_3$, as suggested, indeed, by the lecturer some six or seven years ago.

The study of such relationships necessarily suggests many inquiries. Arranging the entire fifty-eight elements of which the atomic weights are known, in a table similar to the preceding one for the forty-six elements having atomic weights not exceeding 137, some twenty or five-and-twenty new elements would be required to fill up the gaps in the different series; but why should not new elements be discovered having atomic weights as much above that of uranium, 240, as its atomic weight is above that of barium, 137?

Again, does it seem probable that bodies capable of being arranged in such a well-marked numerical series, are really elementary and mutually independent; or is it more likely that the gradation of properties and atomic

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* This Table is based on one published by the author in 1864-5. Similar tables have been constructed by Newlands, Meyer, Mendelejeff, and others. The positions marked X^a, X^b, and X^c, are assigned by Mendelejeff to yttrium, didymium, and cerium, respectively. The recognition of the atomic weight of uranium as 240, is also due to Mendelejeff.

numbers manifested by these bodies, depends on their possession of different increments of common material?

May it not be that the numerical ratio between the atomic numbers of proximate elements, $\frac{x}{y}$ = approximatively $\frac{y}{z}$, is really absolute; and that it will hereafter be proved to be so by a better determination of atomic weights. Seeing that a short time back, cæsium with the atomic weight 133, and rubidium with the atomic weight 85, both occurred as unrecognised impurities in potassium with its atomic weight 39, who shall answer for the absolute accuracy of even the best established of our present atomic weights?

Again, the mean difference in atomic weight between consecutive analogous elements is, in the case of the nine following pairs of elements, lithium and sodium, glucinum and magnesium, boron and aluminum, carbon and silicon, nitrogen and phosphorus, oxygen and sulphur, fluorine and chlorine, sodium and potassium, magnesium and calcium, 16·1; the lowest difference being 15, and the highest 17. The mean difference in the case of the four following similar pairs of proximate elements, phosphorus and vanadium, sulphur and chromium, chlorine and manganese, arsenic and niobium, is 19·25; the lowest difference being 19, and the highest 20·5. Lastly, the mean difference in the case of the seven following similar pairs of proximate elements, calcium and zinc, vanadium and arsenic, manganese and bromine, rubidium and silver, strontium and cadmium, silver and cæsium, tantalum and bismuth, is 24·6; the lowest and highest differences, even in the case of these elements of such high atomic weight, being 23 and 26 respectively. Are these differences in atomic weight only approximatively, or are they indeed absolutely, 16, 20, and 24 respectively; and if so, why should the numerical difference between proximate associated elements be 16 in one set of cases, 20 in another set, and 24 in a third?

ON THE
PART WHICH FERRIC AND ALUMINIC OXIDES PLAY IN THE MANUFACTURE OF SUPERPHOSPHATE;
AND ON THE
COMPARATIVE VALUE OF MINERAL PHOSPHATES.[*]

By T. L. PATTERSON, F.C.S.

(Concluded from p. 257.)

The Comparative Value of Mineral Phosphates.

Continuing to speak of these from a decomposition point of view, and assuming that the tricalcic phosphate is the only valuable ingredient they contain, it will be necessary to consider how far their value is modified by the presence of ferric and aluminic oxide, which, I have just shown, reduce or render insoluble a portion of the phosphoric acid.

It is well known that superphosphate of lime, when applied to the soil, soon has its phosphoric acid precipitated as insoluble tricalcic phosphate, by means of the earthy carbonates contained therein. And it is admitted by all chemists that such precipitated tricalcic phosphate possesses with soluble phosphate of lime, the same value as a fertiliser. It is also admitted by chemists that the great value of soluble or precipitated tricalcic phosphate, compared with mineral phosphates, depends wholly on the much greater solubility of the former. By determining, then, the solubility of ferric and aluminic phosphates, we will be in a position to form more correct notions as to their manurial value. I therefore made two other experiments to clear up this point.

Expt. 10.—Carbonic acid gas was continuously passed through distilled water holding pure precipitated tricalcic phosphate (thoroughly washed and dried in the water-bath) in suspension for five hours, when the undissolved portion was removed by filtration. On heating a portion of the filtrate to boiling with nitric acid and ammonia molybdate, a considerable yellow precipitate was obtained. To another portion of the filtrate was added one drop of a solution of ferric alum, when a slight precipitate was immediately produced. After standing some time, it collected at the bottom of the vessel. The phosphate of lime solution was now added in excess, and the ferric phosphate filtered off. The filtrate gave no blue colour with ferrocyanide, and only a faint reddish tinge with sulphocyanide of potassium, when acidified with HCl. To a third portion of the filtrate ferric alum was added in excess, when the precipitate at first formed re-dissolved. To a fourth portion of the filtrate a drop of aluminic alum was added. An opalescence was immediately produced, and after standing some time, a precipitate of aluminic phosphate separated. When the alum solution was added in excess, the precipitate was re-dissolved. On separating the aluminic phosphate precipitate,—after a carefully conducted precipitation to insure the merest trace of alum in excess,—a drop of the ferric alum produced in the filtrate a second precipitate of ferric phosphate; thus showing aluminic phosphate to be the more soluble of the two.

Expt. 11.—Very finely ground and washed coprolite, suspended in distilled water, was subjected to a continuous stream of CO_2, as was the pure tricalcic phosphate in Experiment 10. The undissolved portion was then filtered off, and the filtrate, when tested with molybdic acid solution, only gave a slight trace of a yellow precipitate. On evaporating the filtrate to one-fourth, however, good evidence of the presence of phosphoric acid was obtained. Aluminic alum produced in the filtrate a barely perceptible opalescence, which, after standing some time, collected as a precipitate at the bottom of the vessel. This precipitate was removed by filtration, and tested with molybdic acid, after solution in dilute nitric acid. A considerable yellow precipitate proved the presence of phosphoric acid. The filtrate evaporated to one-fourth only gave a trace of a yellow precipitate with molybdenum solution. To another portion of the coprolite solution I added a drop of ferric alum; an opalescence was immediately produced. With a slight excess of the precipitant, the precipitate has a yellow colour, caused by the calcic carbonate in solution throwing down hydrated ferric oxide; and when the precipitant is in great excess, no precipitate at all is formed, or that at first formed is re-dissolved. (This is also the case with an excess of aluminic alum). On removing the yellow precipitate thus formed, and dissolving it in dilute nitric acid, abundant evidence of the presence of phosphoric acid was obtained, on heating the solution with molybdic acid to boiling. The filtrate, when evaporated to one-fourth, gave the merest trace of a yellow precipitate when tested with molybdic acid.

The results of these experiments are similar to some made by Warington[*] with another object in view. I thought this precipitation method of experimenting preferable to dissolving separate portions of each in carbonic acid, and determining the amount dissolved, as it produces a minute quantity of these phosphates in the very best possible condition for solution; and, as it has turned out, shows at a glance how insoluble they are compared with ground coprolite and pure tricalcic phosphate. If we arrange them in the order of their solubilities, coprolite will come first, aluminic phosphate next, and ferric phosphate last. I forget the actual solubility of coprolite, and cannot remember where I have seen it stated. Bischof[†]

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[*] Read before the Chemical Section of the Glasgow Philosophical Society, April 29th, 1872.

[*] Chemical News, vol. xvi., p. 253, and vol. xxi., p. 221.

[†] "Chemical and Physical Geology," vol. ii., p. 34.

gives the solubility of wavellite as one part in 6,828,000 parts of carbonic water; but it is likely the precipitated aluminic phosphate here referred to is much more soluble than that. And ferric phosphate must be very slightly soluble indeed, when we consider the extreme delicacy of the sulphocyanide test for iron, and the molybdate of ammonia test for phosphoric acid, and that only minute traces of these bodies were found in the filtrate from the ferric phosphate precipitate.

Now, most agricultural authorities are agreed that ground coprolite in a superphosphate is worthless. Voelcker says,* "Insoluble phosphates in the shape of coprolite powder are not worth anything in an artificial manure, for they are too insoluble to be taken up by the turnip-crop." Of what value, then, is ferric phosphate and aluminic phosphate in a manure? These experiments show, I think, that they have none whatever. But, it may be said, the manufacturer can hardly be expected to lose the phosphoric acid which has thus become unavailable. Neither, would I say, has he any right to charge it to the farmer as precipitated phosphate of lime; he should rather see that he does not pay more than the raw material which contains these objectionable oxides is worth. He will then be able to sell his superphosphate as it ought to be sold,—viz., as valuable only for that portion of phosphoric soluble in water.

At first sight it might appear that Warington's experiments on the absorptive power of soils † contradict all that I have said regarding the worthlessness of the phosphates of ferric and aluminic oxides. He endeavours to prove that hydrated ferric and aluminic oxides in the soil ultimately convert all phosphoric acid added as manure into basic phosphates of these oxides. But a careful study of his results shows, I think, that the conversion of precipitated tricalcic phosphate into ferric and aluminic phosphates is very gradual, and points to the probability of its being a long time before all the phosphoric acid could be thus transformed. My own experiments are in the same direction. In Experiment 9 I have shown how very slowly hydrated ferric oxide removes phosphoric acid from an acid solution. And again, in superphosphate, how slowly ferric and aluminic hydrates precipitate a portion of the phosphoric acid. The fact still remains, too, that root-crops are greatly increased in quantity by the addition of superphosphate of lime to the soil, from the precipitated phosphate of lime thus produced being comparatively more soluble, and easily assimilated by plants. These considerations lead me to think that the rootlets of plants abstract tricalcic phosphate from its CO_2 solution almost as quickly as it is dissolved, and before the ferric and aluminic oxides have had time to absorb any appreciable quantity of it. It is only after the roots have taken what they require that the absorptive action of these oxides will come into full play, and go on precipitating the remaining portion, to give it up very slowly again at some future period to a crop requiring little phosphoric acid; for, as the rootlets feed almost wholly on salts in solution, it is difficult to conceive how a quick-growing plant which requires much phosphoric, acid could assimilate a sufficient quantity from such insoluble materials, and ones, too, the affinities of whose components are so very great. And as, moreover, mineral phosphates are only treated with acid to make them more soluble, for the very purpose of rendering the soil more productive and increasing our crops, we are driven to the inevitable conclusion that any phosphate in a manure less soluble than precipitated tricalcic phosphate,—and certainly any less soluble than ground coprolite,—must be worthless as a fertiliser.

Such being the case, I submit that the present method of valuing a mineral from the percentage of phosphate of lime alone which it contains, is a very erroneous one, and ought to undergo some modification whereby these oxides are taken into account in the valuation. To do this, it will be necessary to calculate—1st, what we may call the "net realisable per cent" of phosphate of lime obtainable from any sample; and 2nd, the weight per cent of sulphuric acid required to reduce it to this condition. With these data, and the known composition and value of some sample taken as a standard, it will be possible to ascertain, very closely indeed, the comparative value of another mineral phosphate.

First, then, in order to find the net realisable percentage of phosphate of lime, we must know, by analysis, the actual percentage of phosphate of lime, ferric oxide, aluminic oxide, and ferrous oxide, which the mineral contains: knowing this, it is simply necessary to calculate for each of these oxides equivalent quantities of phosphate of lime, and deducting the sum of the three from the actual percentage of that earth, the remainder will be the net realisable percentage of phosphate of lime in the sample. If the ferric oxide be multiplied by the factor—

$$1{\cdot}9375,\ \left(\frac{155}{80}=1{\cdot}9375\right),$$

the aluminic oxide by—

$$3{\cdot}0156,\ \left(\frac{155{\cdot}0}{51{\cdot}4}=3{\cdot}0156\right),$$

and the ferrous oxide by—

$$2{\cdot}1528,\ \left(\frac{155}{72}=2{\cdot}1528\right),$$

the amount of tricalcic phosphate equivalent to these oxides is at once found.

And, second, to calculate the weight of sulphuric acid required to reduce the mineral to the condition of net phosphate of lime, we must know the percentage of calcic carbonate, besides that of the ferric and aluminic oxides. If any peroxide of iron and alumina exist as phosphates of these oxides,—and this is sometimes the case,—such oxides are not taken into account in this calculation. The acid I propose to use has a gravity of 1·734 = 147° T., and contains 80 per cent of H_2SO_4. This is of commercial strength, so that a value can always be assigned to it.

1 molecule of $CaCO_3$ requires 1 of H_2SO_4.
1 ,, Fe_2O_3 ,, 3 ,,
1 ,, Al_2O_3 ,, 3 ,,
2 ,, FeO ,, 3 ,,

Calculating a factor for each of these, whereby the weigh of acid of the above strength may be found for all of them, we have the percentage of—

$CaCO_3 \times 1{\cdot}225$ = acid at 147° T.
$Fe_2O_3 \times 2{\cdot}297$ = ,, ,,
$Al_2O_3 \times 3{\cdot}575$ = ,, ,,
$FeO \times 2{\cdot}552$ = ,, ,,

and the sum of the products is the acid required.

It is thus assumed, that were that quantity of acid added to a mineral phosphate, and the mixture allowed to stand some time, as is the case in practice, the product would consist—so far as the bases and acids are concerned—of tricalcic phosphate, ferric phosphate, aluminic phosphate, and calcic sulphate, and the amount of the first in the mixture would be what I have called the net realisable phosphate of lime.

Before concluding, I will just go through the calculation necessary to find the value of one of these phosphates. In No. 2 sample we have—

$Fe_2O_3 = 2{\cdot}03$ per cent $\times 1{\cdot}9375 = 3{\cdot}93$ $Ca_3(PO_4)_2$
$Al_2O_3 = 1{\cdot}75$,, $\times 3{\cdot}0156 = 5{\cdot}28$,,
$FeO = 0{\cdot}34$,, $\times 2{\cdot}1528 = 0{\cdot}73$,,

Total . . . . 9·94

And 55·02 − 9·94 = 45·08 per cent of net phosphate of lime. The acid is found as follows:—

$CaCO_3 = 24{\cdot}47$ per cent $\times 1{\cdot}225 = 29{\cdot}97$ acid.
$Fe_2O_3 = 2{\cdot}03$,, $\times 2{\cdot}297 = 4{\cdot}66$,,
$Al_2O_3 = 1{\cdot}75$,, $\times 3{\cdot}575 = 6{\cdot}26$,,
$FeO = 0{\cdot}34$,, $\times 2{\cdot}552 = 0{\cdot}87$,,

Total . . . . 41·76 ,,

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* Article on Manure, in Ure's "Dictionary," vol. iii., p. 50.

† CHEMICAL NEWS, vol. xxi., p. 207.

100 parts of this phosphate are thus shown to yield 45·08 parts of net phosphate of lime, with the consumption of 41·76 parts of sulphuric acid of 1·734 sp. gr. When Nos. 1 and 3 are calculated in the same way, we see at a glance that No. 3 is superior to No. 2, although it contains less phosphate of lime; and again, because No. 1 contains so much oxide of iron and alumina, how inferior it is to either of them.

	Net Phosphate of Lime.		Sulphuric Acid, 1·734 sp. gr.
No. 1.	24·82	with a consumption of	42·69
No. 2.	45·08	,, ,,	41·76
No. 3.	46·52	,, ,,	24·70

Taking, now, the price of vitriol at 80s. per ton, and that of the mineral phosphate No. 3 as a standard at 52s. per ton, which prices are about their present market value, we can easily calculate the comparative value of the other two: 52s. for 46·52 per cent = 1·118s. for 1 per cent. In No. 2 we have 45·08 × 1·118s. = 50·4s. per ton. But as No. 2 consumes more acid than No. 3, the value of the excess must be deducted from the price so found, to place the two on equality: 41·76 − 24·70 = 17·06 acid, at 147° T., at 80s. per ton; $= \frac{17·06}{100} \times 80\text{s.} = 13·65\text{s.}$, and 50·4s. − 13·65s. = 36·75s., or 36s. 9d., as the true value of No. 2 compared with No. 3 at 52s. per ton. When No. 1 is calculated in the same way, it is found to have a value of only 13·35s., or 13s. 4d. per ton.

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA.

Communicated by J. W. MALLET, Ph.D., M.D.,
Professor of Analytical and Applied Chemistry, University of Virginia.

(Concluded from p. 259).

(5). *Detection of Lead as an Impurity in "Iron reduced by Hydrogen."* By Mr. J. W. C. Davis.

A specimen of "iron reduced by hydrogen," obtained from the eminent firm of E. Rousseau, of Paris, was found to contain lead to the extent of 1·287 per cent of the metal. How this impurity was introduced is not easy to imagine. Its presence is worthy of notice, in view of the pretty large doses of iron by hydrogen sometimes used in medical practice.

(6). *Analysis of Genthite (Nickel-Gymnite) from North Carolina.* By Mr. F. P. Dunnington.

Among a number of minerals kindly sent by Mr. J. A. Reagan, of Tennessee, a laboratory student of last year, there were several specimens of genthite from Webster, Jackson Co., N.C., a locality at which the species is reported,* but without any chemical analysis that I have seen. It occurs as an incrustation, usually not more than a millimetre in thickness, of delicate apple-green colour and resinous lustre, translucent, and of specific gravity = 2·48 at 19° C., completely decomposable by hydrochloric acid. Some portions were greenish-white and opaque: these were rejected as having probably suffered alteration. Very carefully chosen fragments of the pure mineral, having been pulverised and exposed for some time to the atmosphere of a bell-glass over oil of vitriol, gave on analysis:—

Silica	49·89
Magnesia	22·35
Nickel monoxide	16·60
Iron monoxide	0·06
Water	12·36
	101·26

(Of the water 6·00 was lost at 100° C.)

The analysis is not a very satisfactory one, the sum of the constituents found exceeding 100 per cent of the mineral by rather more than a reasonable allowance of error. It was not repeated, from want of sufficient material from which to select fragments that could be relied upon as pure.

So far as the above numbers go, however, they do not correspond to the formula assigned to genthite, namely, $(\frac{2}{3}(MgO,NiO)+\frac{1}{3}H_2O)_2,SiO_2+\frac{4}{3}H_2O$, *i. e.*, deweylite or gymnite with MgO partly replaced by NiO, but (with the whole of the water) more nearly represent a nickel-*aphrodite*, $(MgO,NiO),SiO_2+\frac{3}{4}H_2O$. The previously recorded analyses of genthite from other localities do not agree well with each other, and leave room for useful revision.

(7). *Analysis of a Mineral from Webster, Jackson Co., North Carolina.* By Mr. F. P. Dunnington.

In the same lot of minerals in which the genthite was received there was a specimen of a material much resembling in appearance pimelite from Silesia, but which proved to contain no nickel. It was massive, with indistinct traces of fibrous structure, moderately brittle, with earthy fracture, of slightly yellowish apple-green colour and greenish-white streak, dull on fractured surface, with faintly greasy lustre where cut or rubbed, feeling greasy to the touch, not adhering to the tongue, hardness = about 1·25, sp. gr. = 2·30 at 18° C. It was infusible before the blowpipe, gave off water when heated in a closed tube, and was partly, but not completely, decomposed by strong hydrochloric acid.

Its analysis afforded the following results, the mineral having been previously dried in *air*, at ordinary temperature and pressure, over sulphuric acid:—

Silica	43·87
Alumina..	22·21
Iron monoxide	16·14
Soda	1·05
Water	16·37
	99·64

(Of the water 3·54 was lost at 100° C.)

These figures, if we neglect the small amount of alkali, lead to the formula—

$$2(\tfrac{1}{7}(FeO)_3,\tfrac{3}{7}(H_2O)_3,\tfrac{3}{7}Al_2O_3),3SiO_2+\tfrac{6}{5}H_2O,$$

which is not that of any hitherto-described species; but the mineral, though uniform in character, is in all probability a product of alteration, and it seems unwise to add —by another new *name* for a so-called species—to the already long list of such ill-defined hydrous silicates of earthy character.

(8). *Analysis of a Compact Talc from North Carolina.* By Mr. J. B. Adger.

Amongst the minerals above referred to there was a very beautiful "soapstone, from the Nantahela Mountains, 8 miles from the mouth of Nantahela River, Swayne Co. (formerly Cherokee Co.), N.C." It had been sawn into slabs of about 1¼ inches thick, was very uniform in character, compact, with indistinct traces of foliated structure, white with a faint greenish shade, lustre pearly, streak white, moderately translucent, greasy to the touch, hardness = about 1·25, sp. gr. = 2·82. It resembled somewhat the finer and light-coloured specimens of Chinese jade or nephrite. Analysis afforded—

Silica	57·72
Magnesia	33·76
Alumina	2·52
Iron monoxide	0·64
Water	6·01
	100·65

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* Dana's "Mineralogy," 5th ed., pp. 471 and 782.

If the silica, magnesia, and water, alone be considered, the above numbers correspond pretty closely to the formula $(\frac{5}{6}MgO+\frac{1}{6}H_2O),SiO_2+\frac{1}{6}H_2O$.

The mineral is obviously distinct from the foliated talc from Webster, Jackson Co., N.C., analysed by Genth (*Am. J. Sci.*, II., xxxiii., 200, as quoted in Dana's "Mineralogy," 5th ed., p. 453). In the latter 0·23 per cent of nickel oxide was found, and but 0·34 per cent of water.

In the mineral now described there is no nickel.

University of Virginia
March 12, 1872.

NOTE ON A
PORTION OF THE INCRUSTED SURFACE OF A BLOCK OF JEW'S TIN.
By J. H. COLLINS, F.G.S.,
Secretary of the Royal Cornwall Polytechnic Society.

At a recent meeting of the Royal Institution of Cornwall, a block of "Jews' tin," from Tremethack Moor, in Madron, just purchased for the Institution, was exhibited for the first time to the members. This block was partially covered with a hard and brittle brown coating, in some places as much as ¼ inch thick. Mr. W. Jory Henwood, F.R.S., the late President, before the expiration of his term of office, placed a portion of this coating in my hands for analysis.

The brown colour was not evenly distributed, some parts being darker than others; and under the microscope several minute shining particles were visible—probably particles of metallic tin. The specific gravity of the substance was 5·64.

After a few preliminary trials I found I had just 48 grains at my disposal, which I had previously reduced to a fine powder. On drying this powder, at a temperature of 120° C., it was reduced to 45 grains.

The powder was boiled with distilled water for a time, and yielded a solution from which I obtained 0·5 gr. of tin and 0·3 gr. of chlorine = 0·8 gr. of $SnCl_2$. The powder was then digested with aqua regia, when the solution so obtained yielded 0·5 gr. of peroxide of iron, 0·21 of tin, and 0·2 silica. What remained after this treatment was dark brown, very heavy, and much like ordinary "black tin" of good quality, in appearance: when dried it weighed 43·2 grains. This was reduced in a crucible by cyanide of potassium, and yielded 34·12 grains of metallic tin = to 43·5 grs. of SnO_2.

The quantities thus obtained were calculated to percentages, with the following result:—

Moisture evolved at 120° C.	6·25
Metallic tin	0·43
Chloride of tin	1·66
Peroxide of tin	90·62
Peroxide of iron	1·04
Silica	0·41
	100·41

The crust therefore appears to be composed chiefly of peroxide of tin, somewhat resembling that native variety of cassiterite called "wood-tin," but neither so hard nor so heavy. It has no doubt been formed by the slow oxidation of the outer surface of the block of metallic tin. The slowness of the change is, perhaps, indicated by the dense condition of the incrustation.*

APPLICATION OF ELLIOTT'S PROCESS
TO THE
DETERMINATION OF CARBON IN BONE-COAL GRAPHITE, ANTHRACITE, &c.
By F. A. CAIRNS, A.M.

The employment, for a long time of Elliott's modification of Uhlgren's process, for the determination of total carbon in cast-iron and steel, as described in the *Journal of the Chemical Society of London*, May, 1869, led me to the application of it, to determining graphite alone, and then to determining carbon in bone-coal and anthracite and bituminous coals, by oxidising directly with chromic and sulphuric acids, in Elliott's apparatus. The advantages of the method are decided in point of time, ease, and neatness, in all the applications of it that have been tried here. In point of accuracy it has not been found inferior to any other. There seems to be an impression with many that nothing equals the old process of combustion in a current of oxygen, but where the oxidation by chromic acid is carefully conducted the results seem to be equally good.

The method proposed by W. D. Herman, in the *Journal of the Chemical Society of London*, June, 1870, for the direct combustion of iron and steel, seems to be superior in point of time and directness.

These advantages are enough to recommend the method, although the results are generally by Hermann's figures a little low, were it not for the expensive and troublesome apparatus required.

The delay in filtering the carbon complained of by Herman is probably owing to the use of funnel tubes of insufficient capacity. The same difficulty has occasionally been encountered here, owing to the cause suggested. The determination of total carbon, or graphite, generally occupies from 5 to 6 hours, after the substance has been prepared. Elliott's method of separating carbon seems peculiarly adapted to steel, the difficulties attending it, by Weyl's and other similar methods, being, as is well known, extremely great.

It is unnecessary, perhaps, to allude to matters of manipulation, as Elliott has given very explicit directions. One point which he does not speak of seems worthy of notice, that is, the final weight of the absorption-tube.

If it should have been standing unused for any considerable length of time previously, it should not be weighed after the operation until it has stood some hours with stoppers on the points, to allow it to become thoroughly cooled. Neglect of this precaution may cause an error of one or two tenths of 1 per cent. It has also been found advantageous to apply an aspirator at the beginning of the operation, to prevent the possibility of loss of carbonic acid, through the rubber joints, in consequence of great pressure, caused by rapid evolution of gas.

The method, as applied to total carbon in iron and steel, has been thoroughly tested by others.

To test its accuracy in respect to graphite four equal weights of iron were treated by the ordinary method, and in an exactly similar manner to separate the graphite.

The first was oxidised by Elliott's method, giving 1·50 per cent carbon.

The second was burned in oxygen as usual, giving 1·50 per cent carbon.

The third was treated by Elliott's method, giving 1·493 per cent carbon.

The fourth was lost.

The time consumed was about the same, while all the disagreeable concomitants of furnace combustions, preparation of combustion-tube, &c., and accidents, were avoided by following Elliott's method.

Two samples of bone-coal were then heated by combustion in oxygen, and by oxidising directly with chromic acid.

One gramme of the first was burned in oxygen, and the carbonic acid in the ash determined and assured,

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* On a similar sample of the same specimen, Mr. James Napier, F.C.S., remarks (20th December, 1871):—

"The incrustation which invests the mass of *Jew's-house tin* from Tremethack Moor is a pure peroxide of tin with a mere trace of iron; in short, the metal has been re-converted into *tin-stone*. This is of exceeding interest, as it shows how pure the metal must have been. All analyses of ancient bronze, however, show that the earliest are of the best quality."

giving, after deducting the carbonic acid due to carbonate of lime in the coal, 8·29 per cent carbon.

One-half of a gramme of the same coal was then heated directly with chromic and sulphuric acids, and, after deducting carbonic acid due to carbonates as before, gave 8·20 per cent carbon. One gramme of the second was then burned in oxygen, &c., and gave 10·25 per cent carbon.

One-half of a gramme of the second, treated with chromic acid, &c., gave 10·28 per cent carbon.

The results were so satisfactory that other determinations have been made and compared, and the method adopted in these laboratories for a long time past.

The ordinary method of determining the carbon in bone-coal by loss on igniting the residue, insoluble in chlorhydric acid (previously dried and weighed on a tared filter), is not only imperfect, but involves more time and labour than the oxidation by chromic acid, by which method the determination can be made in less than one hour. saving the delay incident to the cooling of the tube, as suggested before.

The next experiments were made upon anthracite and bituminous coals.

The first taken was a Lehigh anthracite.

The oxygen combustion gave 91·72 per cent, and 91·68 per cent carbon. The direct oxidation by chromic acid and sulphuric acid gave 91·78 per cent carbon. A bituminous coal from Carmelsville, Pa., was then tried. This was a caking coal, and gave a great deal of trouble in the oxygen combustion, with very varying results, viz., 81·29, 82·61, 83·64, and 82·34 per cent. The oxidation with chromic acid gave 83·74 per cent carbon. The operation proceeded with rapidity and ease. In the case of coals, the oxidation should proceed rather slowly, and of course the substance should be very finely pulverised.

Substance.	Weight in grms.		Method.	Time.	Per cent of carbon.
Graphite		1	$H_2CrO_4+H_2SO_4$	5 hrs.	1·500
,,		2	Combustion in oxygen	5 ,,	1·500
,,		3	$H_2CrO_4+H_2SO_4$	5 ,,	1·493
Bone-coal	1·000	1	Combustion in oxygen	3 ,,	8·290
	0·500		$H_2CrO_4+H_2SO_4$	1 ,,	8·200
,,	1·000	2	Combustion in oxygen	3 ,,	10·250
	0·500		$H_2CrO_4+H_2SO_4$	1 ,,	10·280
Anthracite.	0·300		Combustion in oxygen	4 ,,	91·720 91·680
	0·100		$H_2CrO_4+H_2SO_4$	2 ,,	91·780
Bituminous coal.	0·200		Combustion in oxygen	4 ,,	81·290 82·010 83·640 82·340
	0·100		$H_2CrO_4+H_2SO_4$	2 ,,	83·740

Note.—Since writing the above, my attention has been called to two articles in the *American Journal of Science*, of 1848, by Prof. R. E. Rogers and Prof. Wm. B. Rogers, of the University of Virginia, on the determination of carbon in graphite, and the oxidation of the diamond, by means of bichromate of potash and sulphuric acid, with good results, at least as to graphite. By combustion of native graphite in oxygen they obtain 94·16 per cent of carbon, and by the oxidation by means of chromic acid 94·56 per cent. They give no figures in the case of the diamond.

From this it would seem that they are entitled to the suggestion of the use of chromic and sulphuric acids for the determination of carbon.—*American Chemist.*

METHOD OF DETECTING SMALL QUANTITIES OF SUGAR IN URINE.

By J. SEEGEN, M.D., Professor in the University of Vienna.

Trommer's is the most reliable and delicate test for sugar. With its aid, I am able with certainty to make out 0·3 milligramme (0·0046 grain) of sugar dissolved in 10,000 times the amount of fluid. This great delicacy of the test, however, only holds good as long as we have to do with a watery solution of sugar. If, on the contrary, small quantities of sugar are to be detected in urine, Trommer's test is neither delicate enough nor reliable, for two reasons. (1). Urine contains certain substances (colouring matters, creatine) which prevent the suboxide of copper when formed from being precipitated; no separation of the reduced suboxide of copper, therefore, takes place, the blue fluid only becoming yellow or yellowish brown, or presenting a turbid discolouration. (2). The same processes of reduction are also brought about by uric acid; and urine containing a considerable amount of uric acid acts on Fehling's test-fluid exactly in the same manner as urine containing 0·1 to 0·2 per cent of sugar.

The method devised by me has for its object the exclusion of those other constituents of urine which would disturb the proper action of the test, and the transformation, as it were, of the saccharine urine into a watery solution of sugar. Animal charcoal has the property of retaining most of the constituents of urine, more especially the colouring matters and uric acid. After filtering a watery solution of uric acid through animal charcoal I could (provided the charcoal had been good), after repeated filtrations, not find a trace of uric acid in the filtered fluid. Now, in order to detect small quantities of sugar in urine, I proceed in the following manner.

I filter one or two ounces of the urine several times through good animal charcoal until the urine is completely colourless. This operation only takes a few minutes. Then I wash the charcoal on the filter with a little distilled water, and to this water, when filtered off, I apply Trommer's test. The water with which the charcoal has been washed is almost as sensitive to Trommer's test as a watery solution of sugar, and in it I could detect even 0·01 per cent of sugar by a beautiful red precipitate of suboxide of copper, whilst the original saccharine urine, when not filtered, only produces a yellow discolouration of Fehling's test-fluid. With urine containing a little more sugar—say, 0·1 to 0·2 per cent—the water flowing off from the second and third washing acts even more energetically upon the test-fluid than that of the first washing, producing an even purer deposit of suboxide of copper. The water obtained by the subsequent washings thus evidently contains the sugar in a purer form. With normal urine, the water obtained by the above process is either entirely inactive towards Fehling's test-fluid, which remains blue, or it assumes only after a while a slight dichroid (varying colour according as the light falls on or passes through) turbidity. The water obtained by a second and third washing always remains without any effect. When the quantity of sugar has to be determined, the urine must not be filtered through charcoal, as the latter always retains a certain quantity of the sugar which cannot be removed again by washing.—*British Medical Journal.*

NOTICES OF BOOKS.

A Series of Chemical Labels for Use in Laboratories, &c. Published by Mottershead and Co., 1, Market Place, Manchester.

We notice this book of labels because it supplies one of the chief wants of the laboratory—a label clearly printed and having no peculiarity. The common names have been adhered to, prefixes and suffixes being employed only when absolutely necessary; no symbols are attached, but space has been left for the chemist to write them according to his own views. The labels for substances in common use are in duplicate, while the adjective terms "Pure," "Commercial," &c., are provided upon separate slips. We recommend these labels to the notice of every chemist.

CORRESPONDENCE.

THE EVIDENCE OF EXPERTS.

To the Editor of the Chemical News.

Sir,—In your valuable paper there has recently appeared an article entitled "The Evidence of Experts" republished from the *Scientific American*, which, through an erroneous statement, implies an injurious reflection upon several eminent gentlemen. For this reason I trust you will, in the interest of fair play, give room for this brief correction. Had the mis-statement not found its way into a foreign journal it would have been unnecessary to refer to it, since it is part of the history of a chemico-legal investigation in a recent poisoning case, which, while in progress, excited so much attention that every newspaper-reading person in this country is familiar both with the result of the chemical testimony and the names of the experts involved.

The article opens as follows:—"In Philadelphia we have had recently the spectacle of a professed chemist and toxicologist making an examination of the body of a man supposed to be poisoned, and carrying his investigation far enough to convince himself of the presence of antimony; and, forgetting that there was a jury and a public to convince as well, appearing on the witness stand without a particle of proof that he found it except his bare assertion," &c.

The statement that this case (which is none other than the celebrated Wharton poisoning case, tried at Annapolis, Maryland) was tried in Philadelphia is untrue, and the inference which one unfamiliar with this fact must draw, upon reading the sentence, is plainly that a Philadelphia chemist "afforded the spectacle," &c. The injustice of this inference will be apparent when I state that the person affording the spectacle was a citizen of Baltimore; and that the share which Philadelphia chemists had in the case was the honourable one of exposing the untrustworthiness of a bungling analysis, and thus securing the acquittal of the prisoner.—I am, &c.,

William H. Wahl.

Franklin Institute, Philadelphia,
May 20, 1872.

WATER ANALYSIS.

To the Editor of the Chemical News.

Sir,—In your paper of the 15th March, I notice a letter from Assistant-Surgeon Nicholson, in which he states that the analyses which have been made during the past four years of the waters of military cantonments in Bengal were made upon a method drawn up in neglect of the peculiarities of Indian waters, and that, in consequence, the results were in most cases erroneous, and, from a chemical point of view, worthless. I might simply meet this assertion by another, namely, that the method which was employed was directed, so far as needful, to the case of Indian waters, and that as, when I drew up the scheme, I had been engaged in analysing Indian waters for over fifteen years, I knew very well what those peculiarities are. I might also add that the reports of the analysts who used this method, which have been included in my reports to the Government of India on the subject of the analysis of potable waters, have gained the marked approval of the Army Sanitary Commission, as well as of Dr. Parkes and Dr. Angus Smith.

The peculiarities to which Dr. Nicholson specially refers are the frequent presence in Indian waters of a large quantity of nitrates in a sample which is free from organic matter, and *per contra* of water contaminated with sewage containing little or no nitric acid. These, however, are facts which have been not only recognised by me, and by analysts who have worked under my guidance, but also by Dr. Angus Smith, who, in a pamphlet which he wrote upon the subject,—one, by the way, to which I was much indebted in drawing up a scheme for use in Bengal,—drew attention to these very points, and urged their consideration upon those engaged in water analysis. I should hope that no one would think of condemning a water simply because it contained a large quantity of nitrates or of chlorides, though he would do well to remember that, under some circumstances, if positive, the presence of either in any quantity would be a warning not to be despised.

I willingly allow that the scheme of analysis of potable waters which I drew up six years ago, for the use of our water analysts, needs great modifications; but these have been introduced in the revised scheme which, in communication with Dr. Angus Smith and Dr. Parkes, I compiled under instructions from the India Office, when I was lately on furlough. This more recent scheme includes the admirable methods of water analysis introduced by Messrs. Wanklyn and Chapman. I may, however, say that the old scheme was very much modified by me in communication with the individual analysts, and in particular Messrs. Wanklyn and Chapman's processes were introduced so far back as 1868.

While carrying out the analysis of the potable waters of Bengal and adjacent Presidencies, I had to bear in mind that our analysts were not for the most part trained chemists; and, therefore, to have asked from them complete analyses of the mineral constituents of water would have been, for more reasons than one, a very unwise proceeding. Nor do I think that such analyses are generally needful; and I may conclude by saying that if I were now instructed by Government to do over again the work lately done in Bengal, I should feel much inclined to put into the hands of the analysts Messrs. Wanklyn and Chapman's work on water analysis, with instructions to work by it, supplementing the chemical with a microscopical examination of the waters, and charging them, as I have always done, to bear in mind that by no method of analysis can we with certainty detect all dangerous matters in a water, while, however, we may with certainty exclude danger by strict attention to the sanitary condition of the water source.—I am, &c.,

F. N. Macnamara, M.D.

(Surgeon Indian Army, Chemical Examiner
to the Government of India).

Medical College, Calcutta,
April 19, 1872.

ATOMIC THEORY.

To the Editor of the Chemical News.

Sir,—It is evident that "An Aggrieved Atom" is labouring under a misconception of the statements made in the paper referred to. A little thought would have shown him that Whately's definition does not apply to the law of multiple proportions, seeing that the several instances do not "exhibit a conformity to that statement."

It is a very common saying, that the law of multiple proportions is a fact which will remain as one of the bulwarks of the science, whatever becomes of the atomic theory; but nothing is more certain than that the so-called law is completely dependent upon that theory. By the examination of some simple bodies, such as carbonic oxide and carbonic acid, olefiant gas, and marsh gas, Dalton obtained results which led him to think that the elements combined in multiple proportions; but his analyses were further from the theoretical numbers than those now obtained, although the latter do not lead to that law. These discrepancies are overlooked by the use of the atomic theory, but without that theory no law of multiple proportions does exist.—I am, &c.,

R. W. Atkinson.

University College Laboratory,
May 28, 1872.

MISCELLANEOUS.

Chemical Society.—On Thursday last, May 30th, Professor Cannizzaro, of Palermo, delivered the "Faraday Lecture" before a large audience, including a number of ladies. The Lecture Theatre of the Royal Institution had been kindly lent to the Chemical Society for this purpose, and we hope in our issue of next week to be able to lay before our readers a tolerably full abstract of the learned Professor's discourse, entitled "Considérations sur quelques Points de l'Enseignement Théorique de la Chemie." On Friday a dinner was given to the Professor, at which about 150 were present, including the Italian Ambassador and the Right Hon. the Chancellor of the Exchequer.

Improved Blowing Apparatus for Blowpipe Operations.—The *Berg-und-hütttenmännische Zeitung* contains the following description of an improved blower, by Messrs. Armin, Junge, and K. Mitzopulos, of Freiburg. All workers with the blowpipe are well aware how much the work is facilitated by a good blowing apparatus. In qualitative operations it can be dispensed with, but there are certain assays—such as concentrating cupellations for poor silver ores—which cannot be carried on without a blower, save with great exertion. For this reason, nearly every one who has quantitative assays to make provides himself with a blowing apparatus. The ordinary blowing apparatus consists of three parts,—the caoutchouc bellows, the regulator, and the stand for the nozzle. The part which most easily gets out of repair is the caoutchouc regulator, for the operator, looking at his assay, often does not perceive how the regulator gets too much stretched by the blast; the consequence is that the regulator often bursts. When we recollect that such regulators are not to be had everywhere, and that a reserve stock is often useless, from the caoutchouc getting hard, it becomes important to find a substitute which will give as regular a blast and can be made of a more lasting material. It is this that we have had in view in making our regulator, and we will proceed to explain its mode of construction for the benefit of those who might happen to want one. Our regulator gives a perfectly constant blast, which can be used either for the oxidising or the reducing flame, and, after numerous trials, we can say that it is in no way inferior to the caoutchouc regulator. At the same time it is so simple that it can be constructed with great ease, and in a very short time, The arrangement is as follows:—A common wide-mouthed bottle is carefully fitted with a caoutchouc cork bored with two holes, into each of which passes a piece of glass tube bent at a right angle. On to one of these tubes is slipped the caoutchouc tube coming from an ordinary caoutchouc bellows, whilst the other is put in communication with the blowpipe nozzle by means of four pieces of caoutchouc tubing joined by three pieces of glass tube, drawn to a fine point at each end. This forms the main peculiarity of the arrangement. When air is forced into the bottle by the blower, in jerks, it finds a difficulty in escaping as fast as it comes in, on account of the six fine openings in the glass tubes that it has to pass through on its way from the bottle to the nozzle, and it thus acquires a certain pressure in the bottle, and flows out towards the nozzle as a regular blast. The bottle may be about 6 inches high by 3½ inches wide, with a neck 1½ inches in diameter; but of course the dimensions are of no great importance. On the whole a somewhat large bottle is better than a small one. The pieces of glass tubing we use are 2 inches long by ⅓ of an inch in diameter. The apparatus will be stronger if instead of a glass bottle a tin cylinder is used, about 4 inches high by 2 inches in diameter, with two tin tubes opening into its top. Small metal cylinders, with a fine hole at each end, may be used instead of the little glass tubes. A blowing apparatus constructed in this manner will deliver a perfectly regular blast, and will be of practical interest to those who are thinking of working in places where it is difficult or impossible to repair the ordinary instruments.

Oxygen and Oxyhydrogen Gas.—A lively discussion is going on, in scientific and other circles, relative to MM. Tessié du Motay and Co.'s proposals for applying oxygen gas to the lighting of streets and houses, and also to manufacturing purposes. M. Tessié du Motuy's process has been public for some time. It consists, in a few words, of charging elliptical retorts each with 300 kilos. of a mixture composed of 3 parts of manganate of soda and 1 part of oxide of copper intimately blended together. Those retorts are said to yield each 35 cubic metres of oxygen gas in eight operations, each occupying three hours. Eight such retorts are in working order at the Company's Works at Pantin. A steam-engine of 20 horse-power nominal is used to inject compressed air into the retorts, to compress the gas in the cylinders, and to supply the necessary steam for the disengagement of the oxygen. The applicability of the mixed gases to lighting purposes is discussed with much asperity, but this may be attributed in part to objections of the Gas Company which supplies all Paris, and naturally is tenacious of its monopoly. MM. Tessié du Motay and Co. have, however, applied to the Municipal Council of the city for permission to lay down mains and supply-pipes for the distribution of oxygen, and it is believed that the application will be acceded to. The price of the gas is also fiercely disputed. On the one hand, it has been declared that the actual working cost is not more than 15 centimes the cubic metre, while, on the other hand, it is asserted that it cannot be sold at a profit at a lower rate than 1f. 70c. the cubic metre: the Tessié du Motay Company would seem to have settled this latter question, by issuing a public notice, to the effect that as soon as the mains and pipes can be laid down, oxygen gas will be sold to the public—either for lighting purposes, the smelting of metals, or other manufacturing purposes, and, above all, for the purification of the air in houses and hospitals—at a price not exceeding 1 franc the cubic metre, the Company taking upon itself the entire cost of the necessary means of supply. The subject is one of great interest, and as M. Tessié du Motay and his partners ought certainly to know what their products cost, there seems a fair probability that pure oxygen will be placed at the disposition of the manufacturer at a moderate cost. The application of this gas to business purposes seems far more promising than that of its general use in street or house lighting. The necessity for two sets of pipes and two meters, one for each of the gases, and the nicety required in regulating their proportions, are likely to present considerable difficulties in practice.—*Journal of the Society of Arts.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 29, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Researches on Crystalline Dissociation.—P. A. Favre and C. A. Valson.—The second instalment of an exhaustive monograph on this subject, elucidated by a series of tabulated forms exhibiting results of experiments.

Constitution of Clay.—P. de Gasparin.—The author communicates the analysis of a sample of clay taken from the plain of the Vistre not far from Nimes (Département du Gard), this soil being noted for its great fertility. The results of the physical analysis are, in 100 parts—Stones, 1·85; sand, 50·35; matter impalpable and soluble in water, 47·80. Chemical analysis, in 100 parts—Insoluble in nitro-hydrochloric acid, 58·96; soluble in nitro-hydrochloric acid—Carbonate of lime, 27·84; carbonate of magnesia, 0·89; potassa, 0·225; soda, 0·105; peroxide of iron, 4·35; alumina, 2·03; water of combination, 1·45; phosphoric acid, 0·146 (this is equivalent to 6 tons per hectare of surface of the land); organic matter, 4·004.

Absorption-Spectra of the Vapours of Selenium, Protochloride and Bromide of Selenium, of Tellurium, Protochloride and Protobromide of Tellurium, of the Protobromide of Iodine, and of Alizarine.—D. Gernez.

Study on the Salt-Making Industry of Portugal.—A. Girard.—This paper treats exhaustively on the mode of obtaining salt from sea-water by spontaneous evaporation, as practised in the salt-gardens of a certain district of Portugal, whereby the so-called sea-salt is obtained.

Presence of Selenium in Sulphuric Acid Made in France.—I. Personne.—It appears that the sulphuric acid obtained from a manufactory near Paris, and made from a copper-containing pyrites of French origin, contains 0·2 grm. of selenium in 3 litres of acid. As to the source whence this selenium is derived, the author is inclined to ascribe it to the pyrites used in the preparation of the acid. Sulphuric acid made from Belgium pyrites at the same works was found not to contain any selenium. The author is engaged in making further researches on this subject.

Action of Oxygen upon Certain Vegetable Infusions.—L'Abbé Laborde.—This paper contains the detailed description of an experiment made with the view to prove that active oxygen (ozone) is incapable of calling forth fermentation under the conditions alluded to.

Question of the Assimilation of Ammonia by Yeast.—Dr. Griessmayer.—After referring to some discussions which have taken place recently on this subject, the author calls attention to the fact that the ammonio-phosphate of magnesia, when boiled either along with some water and calcined magnesia or even with water alone, gives off its ammonia, which is in a short time completely expelled.

We quote the titles of the two following papers, although the subjects treated of do not precisely belong to chemistry:—

Sanitary Police in reference to Rinderpest.—Dr. Bouley.—The condensed report of the proceedings of the international conference which lately held its meetings at Vienna.

Human Skeleton Found on March 26 in the Caverns of Baoussé-Roussé (Italy) Known as the Grotto of Menton.—E. Rivière.

May 6, 1872.

This number contains the following original papers relating to chemistry:—

Process of Decorative Painting upon Tinfoil.—C. Daniel.—The detailed description of a method of painting with oil paints upon tinfoil stretched uniformly on sheets of plate glass until the painting and varnishing are finished. The tinfoil thus prepared is used instead of paper-hangings, and for decorative purposes; gilding can also be applied.

Light Emitted by the Vapour of Iodine.—G. Salet.—When a crystal of iodine is put into a hard glass tube, the tube sealed, and then strongly heated to redness at some distance from the iodine, the latter substance will be seen, after the heating of the tube has been discontinued, to become volatilised, and to exhibit when entering the still hot portion of the tube a brilliant red light. This experiment may be also made by means of a glass tube provided with a spirally-wound platinum wire, which is made red-hot by means of an electric current.

Conversion of Pyro-Phosphates into Phosphates.—M. Prinvault.—When boracic acid is fused along with pyro-phosphate of soda, and the fused mass taken up with water, there is formed ordinary phosphate of soda; the pyro-phosphate of soda has thus absorbed an equivalent of water of constitution by the action of the boracic acid. It is, the author thinks, probable that phospho-borate of soda is formed, which is decomposed by the water into boracic acid and ordinary phosphate of soda. The action of sulphuric acid, when converting pyro-phosphate of soda into ordinary phosphate of soda, is explained by the author as due to the formation of an alkaline phospho-sulphate.

Quantitative Estimation of Copper by Means of Cyanide of Potassium.—M. Yvon.—The author, first referring to De Lafollye's paper on this subject, asserts that the author just named is not the discoverer of this process. M. Yvon quotes a paper on the subject, published as far back as 1859, by Buignet (*Bulletin de l'Académie de Médicine et Journal de Pharmacie et de Chimie*, third series, vol. xxxv., p. 168). The author (Yvon) further observes that De Lafollye's assertion that the presence of iron or zinc does not interfere with the operation, is quite incorrect, since he (Yvon), who has been engaged since January last in trying to make Buignet's plan practically available, has not as yet surmounted the difficulty which the presence of these metals places in the way of making the otherwise good plan practically useful. The author continues his researches, and intends to publish a complete account thereof.

Formation of Diphenylamine.—Ch. Girard and G. de Laire.—The authors first refer to their paper, published in the *Comptes Rendus*, of 18th March last (see CHEMICAL NEWS, No. 646, April 12, 1872, page 178), and then state that, since their experiments, made according to the directions given by Dusart and Bardy, do not agree in the results obtained with those obtained by the last-named parties. They (Girard and De Laire) request that the Academy may appoint a committee to verify these matters.

This number further contains several important papers and memoirs relating to geology, paleontology, meterology, physiology, and natural history.

Le Moniteur Scientifique Quesneville, No. 364, April, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

On Smells according to the most Recent Chemical and Physiological Discoveries.—F. Papillon.—This excellent essay, too lengthy and too concisely written for any useful abstraction, contains a large and well-digested amount of information, and is elucidated by historical details of importance.

Anthracen and its Derivatives.—Dr. E. Kopp.—The continuation of this lengthy monograph. This portion treats on the action of sulphuric acid upon bichlor-anthracen, $C_{14}H_8O_2$; action of sulphuric acid upon bibrom-anthracen, $C_{14}H_8Br_2$; preparation of alizarine; details of English patents and French *brevets*; on the state in which alizarine is found in madder. To be continued.

Use of Silicate of Soda in Soap-Making.—G. Schnitzer.—This paper contains a valuable amount of practical information relating to soap-boiling by the so-called cold process.

Manufacture of Tartaric Acid in South Germany.—Dr. Kurz.—This memoir is divided into the following chapters:—Preparation of tartrate of lime, (*a*) by means of argol, and (*b*) by means of ley of wine; treatment of the humid wine-yeast; treatment of dry wine-yeast (residues of wine-fermentation); separation of the tartaric acid from the tartrate of lime; refining of argol; estimation of the value of argol.

Bibliography.—"L'Electricité Appliquée aux Arts Mécaniques, à la Marine, au Theatre," par M. E. Saint Edme; 1 vol.; Paris: Gauthiers-Villars. It appears from the review here quoted that this is a very interesting work.

American Journal of Pharmacy, May, 1872.

In addition to several excellent papers and memoirs more particularly bearing upon pharmacy and pharmacognosy, this number contains the following original papers relating to chemistry:—

Lycopersicum Esculentum, Tomato.—T. D. McElhenie.—This paper contains the very detailed account of a series of experiments made with the fruit alluded to mainly for the purpose of ascertaining the nature of the acids present in this fruit; these acids are citric, oxalic, malic, and tartaric, the latter, however, only in very small quantity.

Yaupon.—H. M. Smith.—Under this name the Indians indicate the leaves of the *Ilex Cassine*, a plant indigenous to some parts of the southern States of the Union; these leaves, mixed with those of other species of the same plant, *Ilex vomitoria* and *Ilex dahoon*, form the cassena, the basis of their (Red Indians') famous black drink, used as medicine and as a state drink at some of their religious festivals. The constituents of the yaupon are percentically—Volatile oil, 0·011; wax and tar, 0·466; resin, 3·404; chlorophyll, 2·491; caffeine, 0·122; tannic acid, 4·844; gum and pectin, 8·244; extractive matter, 10·149; starch, pectose, &c., 15·277; nitrogenous matter, 8·138; woody fibre, 34·854; moisture, 7·595; ash, 3·935; total, 101·939. Yaupon is largely used in the southern States as a substitute for tea, coffee, and other stimulants, and is reported to be very beneficial to inebriates who wish to cure themselves of their love of liquor.

Ether Glue.—Dr. J. M. Maisch.—An excellent liquid glue is made by dissolving glue in nitric ether; this fluid will only dissolve a certain amount of glue, consequently the solution cannot be made too thick. The glue solution obtained has about the consistency of molasses, and is doubly as tenacious as that made with hot water. If a few pieces of caoutchouc, cut into scraps the size of buckshot, be added, and the solution allowed to stand a few days, being frequently stirred, it will be all the better, and will resist dampness twice as well as glue made with water.

La Revue Scientifique de la France et de l'Etranger, May 4, 1872.

This number does not contain any original papers bearing on chemistry, but we call attention to the titles of the following papers:—

Superior Agricultural Instruction at the Ecole Centrale des Arts et des Manufactures at Paris.—J. Dumas.—This excellent essay contains a clearly written *exposé* of the means adopted in France for giving instruction in agriculture, practical as well as theoretical.

Continuation of the Lectures on Animal Heat.—C. Bernard.

May 11, 1872.

This number, also, does not contain any original papers bearing on chemistry, but we notice:—

Scientific Journey to Madagascar.—A. Grandidier.—This essay, illustrated with a map, contains some very valuable and reliable information concerning an island which is considerably larger than France, even before the late war, Madagascar having a surface of 590,000 square kilometres.

The Mineral Waters of France.—Dr. Gubler.—An excellent therapeutic essay, from which it appears that the country just named contains most valuable mineral sources, thermal as well as cold, of various kinds.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, March 21, 1872.

Studies on the Dynamometers.—Dr. C. Mène.—The first instalment of a treatise on this subject, illustrated with woodcuts.

Volumetric Quantitative Estimation of Lead.—M. Buisson.—This process is based upon the precipitation of lead by means of bichromate of potassa, and the subsequent complete decomposition of this reagent (used in excess) by iodide of potassium in a liquor acidulated with sulphuric acid. The iodine set free is next estimated by starch and hyposulphite of soda. Although this process yields reliable results with nearly pure lead, many metals interfere with its correctness, as, for instance, silver, bismuth, copper, baryta.

Estimation of Water in Animal Charcoal.—Dr. Walz.—From a series of experiments made by the author, he comes to the conclusion that a weighed sample of animal charcoal, such as is used in sugar refineries, when exposed for an hour to a temperature of 250° F., is completely dried; a higher temperature should be avoided, since then, probably owing to oxidation, an increase of weight is observed. Animal charcoal, though apparently dry, may absorb as much as 15 per cent of water, and usually contains about from 5·5 to 7 per cent of moisture.

March 28, 1872.

Under the title—

Actualités—Dr. C. Mène.—This number opens with the first instalment of a discussion on fermentation, decay, catalytic force, and ferment.

Absorption of Metallic Salts by Mordanted Woollen Fabrics.—P. Havrez.—This paper, not well suited for any useful abstraction, contains some very important results of researches relating to the practice of mordanting.

Description of a Newly-Devised Apparatus for the Economical Manufacture of Illuminating Gas.—M. Martin.—This contrivance is specially arranged for making gas from either liquid or solid volatile hydrocarbons, which are first, in a special vessel, volatilised under high pressure, and the vapours next converted into gas by passing them through a red-hot retort filled with lumps of coke. The apparatus, illustrated by a woodcut, can be placed in a kitchen, and is especially made for use in isolated houses and country places situated at a distance from large gas-works.

Les Mondes, May 2, 1872.

French Association for the Advancement of Science.—The inaugural meeting of this Association has been held under the presidency of Dr. C. Bernard, assisted by MM. Dumas, Wurtz, and Broca. After the approval of the statutes which rule this Association, an inaugural discourse was delivered by Dr. Wurtz. This newly-organised institution is akin, in its scope and arrangements, to the British Association for the Advancement of Science. In some French town or city the Association will hold a meeting annually, while it is also intended to advance science by other means.

Preparation of Caustic Soda by means of Sulphuret of Sodium.—Tessié du Motay.—The author distinguishes between processes by the dry and the wet way. The former is described as follows:—When one equivalent of sulphuret of sodium is mixed and fused with one equivalent each of caustic soda, hydrate of lime, and metallic iron (either cast or malleable), and these substances heated to redness, the sulphuret of sodium is completely converted into caustic soda, while sulphuret of iron is simultaneously formed. This reaction is explained by the author as follows:—The water of the hydrate of soda, or of the hydrate of lime, is decomposed by the iron which becomes oxidised, hydrogen is set free, oxide of sodium formed, and next sulphuret of iron; the soda is separated from the last-named substance by lixiviation with water. As regards the process by the wet way, the author converts the sulphuret of sodium into a basic phosphate of soda by means of a rather circuitous process (scientifically correct, but not well adapted for industrial application), and this basic phosphate of soda is next converted into caustic soda by means of caustic lime.

May 9, 1872.

Pathologico-Chemical Laboratory.—The Municipal Council of Paris has made the necessary arrangements to construct a pathologico-chemical laboratory to be added to the School of Practical Science established in that city.

Electro-Magnetical Apparatus for Medical Use and Physiological Applications.—MM. Trouvé and Onimus.—The detailed description illustrated by woodcuts of very ingeniously-contrived and well-arranged electro-magnetical apparatus, especially suited for medical use and physiological experiments.

Preservation of the Wood of Telegraph-Poles in Norway.—F. Michel.—The property of freshly cut down trees of continuing the circulation of the sap is made use of to cause the wood (fir trees) to absorb sulphate of copper, introduced into holes some 16 to 18 centimetres in depth, and closed by wooden plugs or corks coated with tar or varnish. The introduction of sulphate is repeated two or three times a year for a period of two or three years, during which time the poles absorb a sufficient quantity of sulphate of copper to prevent the wood from decay for ten to twelve years in the climate of Norway, where the winters are very severe, but comparatively dry.

May 16, 1872.

This number has not yet been received.

May 23, 1872.

Atelier de Silex Préhistoriques.—E. Lejeune.—The author states that he has discovered, in a secluded locality,—Escalles (Pas-de-Calais),—a workshop, wherein, aided by excellently-constructed machinery and well-made tools, pre-historic silex and quartz implements are made on the large scale, the workshop being situated in the neighbourhood of a number of tumuli.

Submarine Hydro-Electric Cable.—Rev. F. Moigno.—A preliminary notice of an invention made by F. Tommasi, whereby it is stated that telegraphic submarine communication can be obtained without the use of the ordinary electric cables, and at greatly lessened cost and very much increased rapidity of transmission of signals.

Wood-Carving by Machinery.—H. A. Lanteigne.—The description, illustrated hy a woodcut, of an apparatus for carving wood.

Bibliography.—Under this heading we meet here with an exhaustive review of the work just published:—"La Création du Monde organisé d'après les Naturalistes Anglais et Allemands," par M. Charles Martins, Professeur de Botanique à la Faculté des Sciences de Montpellier.

Petites Annales de Chimie.—Dr. Maumené.—The continuation of a series of papers on chemical philosophy.

May 30, 1872.

This number only contains the index for the first four months of this year.

MEETINGS FOR THE WEEK.

Monday, June 10th.—Royal Geographical, 8.30.
—— London Institution, 4. Prof. Bentley, F.L.S., "On Elementary Botany."
Tuesday, 11th.—Civil Engineers, 8.
—— Photographic, 8.
Thursday, 13th.—Royal, 8.30.
—— Royal Society Club, 6.
Friday, 14th.—Astronomical, 8.
—— Quekett Club, 8.

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NEW WORK BY PROFESSOR TYNDALL.
On Tuesday, June 11, in One Volume, 8vo.,

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London: Longmans, Green and Co., Paternoster Row.

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THE CHEMICAL NEWS.

Vol. XXV. No. 655.

ON THE SEPARATION
OF
PHOSPHORIC ACID, FERRIC OXIDE, ALUMINA, LIME, AND MAGNESIA.[*]

By THOMAS ROBERTSON OGILVIE, F.C.S.

To separate and accurately estimate phosphoric acid, ferric oxide, and other bases, is one of the most difficult problems in analysis. It is also of great commercial importance, on account of the large quantities of ferruginous phosphatic minerals employed in the manufacture of superphosphate of lime: besides, owing to the increased demand of late for these minerals, they have considerably advanced in value, and merchants now ask from analysts a greater delicacy and minuteness of detail in their results than formerly. Another reason why a correct and speedy method of separation is of consequence has just been clearly shown by a member of this section, in the prominent part which ferric oxide and alumina play in the manufacture and composition of artificial manures.[†]

The method generally recommended is to dissolve the mineral in acid, evaporate to dryness, filter from the siliceous matter, precipitate the lime as oxalate, which, after being washed, dried, and ignited, is weighed as carbonate. The filtrate is evaporated to a small bulk, citric acid added to hold up the ferric oxide and alumina, and the phosphoric acid separated as ammonio-magnesian phosphate. To the fluid from this precipitate is added some nitrate of potash and sufficient carbonate of soda to effect the decomposition of the chloride of ammonium, the whole brought to dryness, and ignited, so as to decompose and remove the citrate and other ammoniacal salts. The residue is dissolved by digestion for some time in acid, and the ferric oxide and alumina are precipitated in the usual way. The magnesia, which is present in mineral phosphates in very small quantities, is determined in another portion of the acid solution by separating the lime with oxalate of ammonia, the ferric oxide and alumina with ammonia and acetic acid, and then allowing the filtrate—which contains a large quantity of phosphoric acid—to stand till the magnesia separates as ammonio-magnesian phosphate.

This plan of estimation is objectionable on two grounds:—first, because phosphoric acid cannot be estimated with accuracy in presence of oxalate and citrate of ammonia, if they exist in any considerable quantity; and second, because the removal of the chloride of ammonium and the decomposition of the other ammoniacal salts are tedious and troublesome operations.

Another method of separating ferric oxide and alumina is that given by Warington, in his excellent paper on "The Analysis of Mineral Phosphates."[‡] To the acid solution of the mineral large excess of caustic soda is added, which gives a precipitate of ferric oxide and phosphate of lime. The iron may be estimated by the permanganate process, or separated from the phosphate of lime by dissolving in hydrochloric acid, precipitating with ammonia, and adding large excess of acetic acid, which leaves the iron as phosphate. It will contain a little lime, which may be removed by re-dissolving and re-precipitating. The filtrate from the ferric oxide and phosphate of lime contains the alumina, and is treated with chloride of barium to remove phosphoric acid, with carbonate of soda to separate the excess of baryta, and then with ammonia to precipitate the alumina. This mode of determining the oxides has not come into frequent use, owing to the great deal of manipulation involved, and because of the difficulty of obtaining caustic soda free from alumina.

About a year ago our leading agricultural chemists began to adopt Sonnenschein's method of separating phosphoric acid as phospho-molybdate of ammonia; and since then the extraordinary discrepancies previously so frequent have to some extent ceased. Regarding this process Warington, in the paper already quoted, states that "it is inadmissible, from the large amount of phosphoric acid to be determined" in mineral phosphates: and Fresenius says that "the phosphoric acid in the substance taken to operate upon should not be allowed to exceed 0·1 grm.,"[*] which would be equivalent to about 0·3 grm. of the mineral, a quantity so small that few chemists would care to work upon it in ordinary commercial analysis. Watts also repeats these statements: he says "it cannot be depended upon for giving exact results, excepting when the quantity of phosphoric acid to be determined is very small."[†] I have thoroughly satisfied myself, however, by a number of experiments, that perfectly satisfactory results may be got by employing a quantity of the substance containing even 0·3 grm. of phosphoric acid. We may therefore separate the phosphoric acid in such minerals as apatite, coprolite, Rhenish phosphorite, and South Carolina phosphate, by this highly-accurate method, and in the filtrate from the phospho-molybdate of ammonia determine the bases.

Before referring to the latter point, which is the more immediate subject of this paper, I shall briefly give the details of Sonnenschein's process.

(*a*). *Separation of Phosphoric Acid as Phospho-Molybdate of Ammonia.*—Five grms. of the finely-ground mineral are dissolved in nitric acid, evaporated to dryness so as to render any soluble silica insoluble and avoid its interfering with the subsequent determination of the bases, re-dissolved in the same acid, filtered from the siliceous matter, and the filtrate made up to 250 c.c. The siliceous matter should be free from ferric oxide; if not, it must be digested in strong acid until it becomes white, and the solution added to the original filtrate. Of the fluid 50 c.c., containing 1 grm., are transferred to a beaker, a sufficient quantity of molybdenum solution added, and the whole allowed to stand—at a temperature of 40° C.—until the precipitate thoroughly subsides, for which four hours are generally sufficient. The molybdenum solution is prepared in the following manner:—10 grms. of molybdate of ammonia are dissolved in 40 c.c. of ammonia (0·96 sp. gr.), heat applied gently, then 160 c.c. of a mixture of equal parts of nitric acid and water added, care being taken to keep down the temperature. In this way a solution of known strength is got, and little difficulty will be experienced in using the requisite quantity, namely, 40 parts of molybdic acid for every 1 part of phosphoric acid present. The phospho-molybdate of ammonia is filtered, washed with a mixture of equal parts of the molybdenum solution and water, then dissolved in ammonia, and, after neutralising the greater part of the free alkali with hydrochloric acid, "magnesia-mixture" added in *slight* excess and the phosphoric acid precipitated as ammonio-magnesian phosphate.

The filtrate from the phospho-molybdate of ammonia will contain all the bases as nitrates, and Fresenius[‡] gives the following plan of separating them from the molybdic acid:—Mix the acid fluid in a flask with ammonia to alkaline reaction, add sulphide of ammonium in sufficient excess, close the mouth of the flask, and digest the mixture. As soon as the solution appears of a reddish-yellow colour, filter off the fluid which contains sulphide

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[*] Read before the Glasgow Philosophical Society, April 29, 1872.

[†] "The Part which Iron and Aluminium Oxides Play in the Manufacture of Superphosphates; and on the Comparative Value of Mineral Phosphates," Chemical News, vol. xxv., pp. 255, 268.

[‡] Chemical News, x., p. 1.

[*] Fresenius, "Quantitative Analysis." 4th edition, p. 274.

[†] Watts's "Dictionary," vol. iv., p. 546.

[‡] "Quantitative Analysis," 4th ed., p. 285.

of molybdenum and the alkaline earths, wash the residue of sulphide of iron and alumina with water containing a little sulphide of ammonium, and determine the oxides by the usual methods. The sulphide of molybdenum is next precipitated from the filtrate with hydrochloric acid, and the lime and magnesia estimated in the filtrate. But such a process is too troublesome and protracted for ordinary use, and I propose to render it more simple and expeditious, by taking advantage of the well-known property of molybdic acid of remaining in solution in presence of free alkali, and determining the bases in its presence.

(*b*). *Separation of Ferric Oxide and Alumina.*—The filtrate from the precipitate of phospho-molybdate of ammonia, consisting of a nitric acid solution of molybdic acid, ferric oxide, alumina, lime, and magnesia, is placed in a beaker, and cautiously neutralised with ammonia, care being taken that the temperature does not rise above 40° C., and that the alkali is added only in slight excess; allow to stand in a warm place until the precipitate completely settles, filter the clear supernatant fluid, wash the precipitate by decantation, then transfer it to a filter, and finish the washing. Next, re-dissolve the precipitate in weak nitric acid, re-precipitate, and wash in the same careful manner. If the filtrate is found to contain any lime it is added to the original solution. The precipitate is dried, ignited, and weighed as ferric oxide and alumina. By re-dissolving in hydrochloric acid the former is rapidly determined, after reduction with zinc, by Penny's bichrome process, and the latter found by difference.

(*c*). *Separation of Lime.*—The alkaline filtrate from the ferric oxide and alumina is treated with oxalate of ammonia, and allowed to stand in a warm place, until the precipitate of oxalate of lime has completely subsided, which will take place in about three hours. The clear fluid is then filtered, the precipitate washed by decantation and otherwise, dried, and ignited; care being taken that no caustic lime is formed.

(*d*). *Separation of Magnesia.*—To estimate the magnesia in the solution from the oxalate of lime, the ammonia salts must be removed by evaporating it to dryness and igniting the residue, which will leave only magnesia and molybdic acid. It is digested with a little nitric acid to dissolve the magnesia, and then neutralised with an excess of ammonia to render soluble the molybdic acid. To the clear solution phosphate of soda is added, and the magnesia removed as ammonio-magnesian-phosphate.

To test the correctness of this mode of separating phosphoric acid, ferric oxide, alumina, lime, and magnesia, a solution was prepared, containing a mixture of these bodies in known proportions, and the following are the details of the experiments. In (*a* 1) and (*b* 1) magnesia was present, and in (*a* 2) and (*b* 2) it was absent.

	Used.	Found.		Used.	Found.	
	(*a*).	(*a* 1).	(*a* 2).	(*b*).	(*b* 1).	(*b* 2).
PO_5	0·1984	0·1982	0·1989	0·0397	0·0409	0·0409
Fe_2O_3	0·0300	0·0312	0·0297	0·1500	0·1485	0·1460
Al_2O_3	0·0200	0·0208	0·0203	0·1000	0·1015	0·0980
CaO	0·3298	0·3282	0·3326	0·1319	0·1310	0·1327
MgO	0·0570	0·0555	—	0·1140	0·1146	—
	0·6352			0·5356		
Found: grms.		0·6339	0·5815		0·5365	0·4176
Used: grms.		0·6352	0·5782		0·5356	0·4216

As nearly all mineral phosphates contain only a few tenths of a per cent of magnesia, it would perhaps be preferable to take a fresh portion of the acid solution of the mineral, and separate the lime as oxalate, evaporate the filtrate to a small bulk, add ammonia, then acetic acid, and remove the ferric oxide and alumina as phosphates; then render the fluid alkaline, and allow to stand for some time, when the small quantity of magnesia will be deposited as ammonio-magnesian phosphate.

This plan of separating phosphoric acid, ferric oxide, and other bases, is simple and easy, as it involves only operations of the most elementary kind, and avoids the use of sulphuretted hydrogen. It is very expeditious: the bodies may all be separated in about 12 hours,—and even this time may be shortened if the separation of the phosphoric acid, ferric oxide, and alumina, in one portion of the acid solution, and the lime and magnesia in another, are gone on with simultaneously. Although the solution from the phospho-molybdate of ammonia containing the bases is of considerable volume, it may be filtered very rapidly from the ferric oxide and alumina, and then from the oxalate of lime, if the precipitates are allowed to settle properly. The method is also highly accurate; the phosphoric acid is determined by a process which may be placed in the front rank for delicacy and correctness, and the other bodies are got with all desirable precision.

NEW RESEARCHES ON THE PHOSPHORUS BASES.*

By A. W. HOFMANN, LL.D., F.R.S.,
Professor of Chemistry in the University of Berlin.

(Concluded from page 247).

IV. *Primary and Secondary Ethylic Derivatives of Phosphoretted Hydrogen.*

After what has been elicited by the study of the methyl compounds, there could be but little doubt as to the phenomena to be observed by repeating the experiments in the ethyl series. Nevertheless the study of the ethyl compounds presented an interest of its own. In the first place, it was desirable experimentally to generalise the new method by applying it to different groups; again the properties likely to be possessed by the ethylphosphines, and more particularly their higher boiling-points, appeared to promise that the experimental difficulties of this inquiry would be materially diminished by working in the ethyl series.

The formation of the ethylphosphines by means of ethyl iodide, phosphonium iodide, and zinc oxide proceeds with the same facility and precision as that of the methylated compounds. The digestion, however, must be conducted at a somewhat higher temperature. Exposure of the tubes to a temperature between 140° and 150° C. for six or eight hours is sufficient for the transformation. The product of the reaction in this case, exactly as in the methyl series, contains the primary and secondary bases only. Their separation and preparation in a state of purity is carried out in exactly the same manner as that of the corresponding methyl compounds.

Ethylphosphine—

$$C_2H_7P = \left.\begin{matrix}C_2H_5\\H\\H\end{matrix}\right\}P.$$

Colourless, transparent, mobile liquid, powerfully refractive, lighter than water, in which it is insoluble. It is easily soluble in alcohol and ether. These solutions are without any action on vegetable colours. Ethylphosphine boils constantly at 25°, and is then seen to possess exactly the boiling-point of dimethylphosphine with which it is isomeric.

$$\left.\begin{matrix}CM_3\\CM_3\\H\end{matrix}\right\}P = \left.\begin{matrix}C_2H_5\\H\\H\end{matrix}\right\}P = C_2H_5P.$$

The odour of this compound is overwhelming; it strongly recalls that of the formonitriles, producing more especially the same sensation of bitterness on the tongue and to the very depth of the throat. Odour and taste are, obviously, in consequence of the volatility and oxidability of the compound, far less persistent. The vapour

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* A paper read before the Royal Society.

of ethylphosphine bleaches cork like chlorine; very peculiar, too, is its action on caoutchouc, which in contact with it becomes translucent, losing its elasticity. Chlorine, bromine, and nitric acid inflame the compound. Ethylphosphine combines with sulphur and carbon bisulphide, though not nearly as energetically as triethylphosphine; nor are the compounds thus produced crystalline, like the corresponding derivatives of triethylphosphine, but liquids, which are as yet but imperfectly studied.

Like the monomethylated base, ethylphosphine unites with chlor-, brom-, and iod-hydric acids to saline compounds. The solution of the chlorhydrate yields with platinum perchloride a double salt, crystallising in fine crimson-red needles, which resemble freshly-prepared crystallised chromic acid. The most beautiful salt of ethylphosphine is the iodhydrate. It forms white four-sided tables, which, in a current of hydrogen, may be sublimed even at the temperature of boiling water. The aspect of the substance forcibly recalls that of ordinary sal-ammoniac. Analysis showed that this salt possesses the composition assigned to it by theory, viz.:—

$$C_2H_8PI = (C_2H_5)H_2P.HI.$$

The iodhydrate easily dissolves in water, but not without being entirely decomposed. In dry air the crystals of the salt are permanent; but even when breathed upon they are altered, their decomposition being indicated by the powerful odour emanating from the crystals, which, when dry, are perfectly inodorous. When a crystal is thrown upon water, it is seen to disappear with evolution of gas. Alcohol dissolves the iodhydrate, but only with partial decomposition; in ether it is insoluble. The only solvent in which the salt was found to be soluble, though likewise but sparingly, is concentrated iodhydric acid. Addition of ether to this solution causes the salt to separate in large, well-formed tables, having often a length of 1 centimetre; they are generally so thin that their surface presents magnificent iridescence.

Diethylphosphine—

$$C_4H_{11}P = \left.\begin{matrix} C_2H_5 \\ C_2H_5 \\ H \end{matrix}\right\} P.$$

Transparent, colourless, perfectly neutral, mobile liquid, floating upon water, in which it is insoluble, powerfully refracting light. It boils constantly at 85°, *i.e.* 66° higher than the primary base. The odour is penetrating and most persistent, very different from that of ethylphosphine, distantly resembling that of triethylphosphine. The diethylated compound attracts oxygen with far more energy than the primary base; and more than once have I seen this compound bursting into flame on opening a bottle. Diethylphosphine combines with sulphur and carbon bisulphide; these combinations, like those of the monoethyl base, are liquids.

The secondary phosphines readily dissolve in acids. The salts, as far as my experience goes, are difficult to crystallise, with the exception of the iodhydrate. The solution of the chlorhydrate gives, with platinum perchloride, a fine platinum salt, crystallising in orange-red prisms, which are, however, easily changed. It is interesting to perceive that the salts of diethylphosphine resist the action of water, whilst those of the monoethylated base are readily decomposed; the deportment of the phosphines is thus seen to afford an instructive illustration of the increased basicity the phosphoretted molecule acquires with the number of ethyl groups it has incorporated.

Products of Oxidation of the Primary and Secondary Ethylphosphines.

It is my intention to study in detail the products of oxidation of ethyl- and diethylphosphines, which, according to special circumstances, appear to vary to a considerable extent. Hitherto I have examined only the terminal compounds. These are perfectly analogous to the products similarly obtained from the methylated base; they need not, therefore, be more than cursorily mentioned.

Ethylphosphine Acid.—Preparation, appearance, and properties of the body obtained by the action of nitric acid upon ethylphosphine resemble in every respect methylphosphine, and described in a previous communication. The ethyl compound is likewise exceedingly soluble in water, alcohol, and ether; it fuses at 44°, and may be distilled without decomposition. The formula $C_2H_2PO_3 = (C_2H_5)H_2PO_3$ was fixed by the analysis of a silver salt. This salt was formed by saturating the free acid partially with silver oxide, and precipitating the concentrated liquid by alcohol. It is an amorphous, yellowish powder, insoluble in water and alcohol, the composition of which is represented by the formula

$$(C_2H_{11})Hg_2PO_3.$$

Diethylphosphinic Acid.—On treating diethylphosphine with nitric acid, all the phenomena present themselves which are observed in the corresponding experiment in the methyl series. The acid produced, however, has only been seen as yet in the liquid state, refusing to solidify even at a temperature of 25°. The composition of the acid, $C_4H_{11}PO_2 = (C_2H_5)_2HPO_2$, was established by the analysis of a silver compound. The latter was obtained by nearly neutralising the acid by silver oxide and precipitating the evaporated liquid by alcohol. The silver diethylphosphinate contains

$$C_4H_{11}HgPO_2 = (C_2H_{11})_2HgPO_2.$$

The product of oxidation of the ethylated phosphorus bases are thus proved to be perfectly analogous to the group of methyl bodies previously described, as seen by glancing at the following table:—

$$\begin{array}{ll}
\text{Orthophosphoric acid,} & \left.\begin{matrix} HO \\ HO \\ HO \end{matrix}\right\} PO. \\
\text{Ethylphosphinic acid,} & \left.\begin{matrix} C_2H_5 \\ HO \\ HO \end{matrix}\right\} PO. \\
\text{Diethylphosphinic acid,} & \left.\begin{matrix} C_2H_5 \\ C_2H_5 \\ HO \end{matrix}\right\} PO. \\
\text{Triethylphosphinic oxide,} & \left.\begin{matrix} C_2H_5 \\ C_2H_5 \\ C_2H_5 \end{matrix}\right\} PO.
\end{array}$$

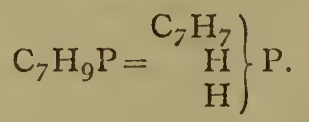
V. *Aromatic Phosphines.*

The well-defined results which the easy and handy use of phosphonium iodide, as a source of phosphorus compounds, has furnished in the methyl and ethyl series, and, as I shortly intend to communicate to the Society, also in the propyl, butyl, and amyl series, very naturally created the wish of drawing the aromatic phosphines as well into the circle of my researches. It appeared especially worthy of interest to study an aniline with phosphorus in the place of nitrogen,—in other words, phenyl phosphine and, indeed, the whole series of phenylated phosphorus bases. I have instituted many experiments in the hope of obtaining these bodies, but as yet without success. Considering the remarkable inactivity of benzol chloride and analogous benzol compounds under the influence of ammonia, I could scarcely hope to form phenylphosphine by acting on phosphonium iodide with benzol chloride. Nevertheless the experiment was made; but although tried under varying conditions, I have not been able to observe the generation of phosphine bases in this process. The benzol chloride is reduced to benzol, which itself is then no further changed, even by raising the temperature, as the interesting researches of M. Baeyer have already proved.

But even the action of phosphonium iodide on phenol, from which, looking at the experience gathered in the methyl and ethyl series, I was fairly entitled to hope that at least the tertiary and quartary compounds would emerge, gave rise to changes very different from those anticipated. The singular phosphorus bodies generated in this reaction claim further examination. New processes, different from those hitherto followed, must therefore be devised for the production of phenylphosphine.

Exactly as in the formation of phenylphosphine, I have hitherto failed in that of phosphoretted zolicidine. On the other hand, the preparation of a phosphorus base corresponding to benzylamine presents no difficulty. Considering that benzyl chloride is easily converted into benzylamine by the action of ammonia (as the researches of Cannizzaro and Limpricht have shown), it could not possibly be doubted that by causing benzyl chloride and phosphonium iodide to meet under appropriate circumstances, an aromatic phosphorus base would be obtained.

Benzylphosphine—



$$C_7H_9P = \left.\begin{matrix} C_7H_7 \\ H \\ H \end{matrix}\right\} P.$$

For the preparation of this body it is not necessary to employ the benzylchloride in its pure state. It suffices to operate with toluol chlorinated whilst hot, which boils between 150° and 180°. The substances to react on one another are employed in the same proportions which, in the methyl and ethyl series, have yielded satisfactory results, viz., 2 mols. of benzylchloride, 2 mols. of phosphonium iodide, and 1 molecule of zinc oxide. A digestion of six hours' duration at 160° is sufficient for the formation of benzylphosphine. When the reaction is finished the digestion-tubes contain a white mass of crystals, which is generally forced out by the phosphoretted hydrogen escaping when the tubes are opened. When the product of the reaction was distilled with the vapour of water, an oily liquid, heavier than water, possessing an extremely characteristic persistent odour, passes over. This was separated from the water by means of a separating funnel, dried by allowing it to stand on caustic potassa, and submitted to fractional distillation in a current of hydrogen. It commenced boiling a few degrees above 100°; the mercury then rose rapidly to 180°, at which temperature a large quantity of a colourless powerfully refractive liquid distilled over. That passing between 180° and 190° was collected apart from the earlier distillate, consisting chiefly of toluol (which is regenerated from the benzylchloride by the phosphonium iodide). The liquid boiling at 180° is benzylphosphine; the residue in the retort contains dibenzylphosphine and other products. Purified by a second distillation in a current of hydrogen, benzylphosphine is found to have the constant boiling-point 180°. In contact with the air the aromatic phosphorus base attracts oxygen with such avidity that the thermometer rises to 100° and more, and thick white clouds are formed.

Benzylphosphine is insoluble in water, but easily so in alcohol and ether. The aromatic phosphorus base shares the characteristic property of the other primary phosphines, viz., that of forming a crystallisable iodhydrate. This is obtained by mixing the phosphine with fuming iodhydric acid, when it falls as a white and apparently amorphous mass. The insolubility of the iodine compound presents an easy method of recovering any benzylphosphine that may have passed over in the first distillate containing toluol. The white precipitate of benzylphosphine iodhydrate dissolves on warming in iodhydric acid, and forms, as the solution cools, white needles, often more than a centimetre long, which, on contact with water, are decomposed into the acid and base. By washing with dry ether and drying in a stream of hydrogen at 100°, the iodhydrate may easily be obtained in a state of purity for analysis. In this experiment, occasionally well-formed tables are produced of considerable dimensions and great beauty. The salt has the composition—

$$C_7H_{12}PI = (C_7H_2)H_2P.HI.$$

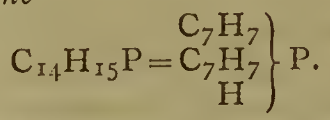
Benzylphosphine combines likewise with concentrated chlorhydric and bromhydric acids. I have not, however, been able to obtain these compounds in crystals. The chlorhydrate gives, with platinum chloride, a yellow insoluble precipitate.

Benzylphosphine forms, according to the equation—

$$2C_2H_2Cl + 2[H_3P.HI] + ZnO =$$
$$= 2(C_2H_2)H_2P.HI + ZnCl_2 + H_2.$$

This equation, however, shows only one phase of the reaction in which at the same time several other substances are formed.

Dibenzylphosphine—



$$C_{14}H_{15}P = \left.\begin{matrix} C_7H_7 \\ C_7H_7 \\ H \end{matrix}\right\} P.$$

This compound is contained in the liquid remaining in the retort after the distillation of benzylphosphine. By long standing, especially in presence of solid alkali, this liquid solidifies to a soft mass of crystals, which are collected on a linen filter in order to free them, by pressing, as much as possible from adhering liquid. The still strongly-coloured crystals are then dissolved in alcohol and treated with a little animal charcoal. The colourless liquid thus obtained deposits, on cooling, beautiful white crystals of the new compound. By repeated crystallisation from boiling alcohol dibenzylphosphine is obtained in a perfectly pure state. Thus prepared, the phosphine forms large brilliant needles, mostly grouped in stars or glistening tufts, perfectly tasteless and colourless, which are insoluble in water, but dissolve, though sparingly, somewhat in boiling alcohol. In ether they are nearly insoluble. The crystals melt at 205°; at a higher temperature they volatilise, but not without partial decomposition. With the entrance of the second benzyl group, the basic characters, which in the monobenzylphosphine are still perceptible in a marked manner, have entirely disappeared. Dibenzylphosphine dissolves in no acid, nor have I succeeded in obtaining a platinum salt. In this respect the secondary aromatic phosphine essentially differs from the analogous bodies in the ethyl and methyl series, which are distinctly marked bases. This absence of basic properties cannot, however, be looked upon as strange, since even in the secondary aromatic amines the tendency to form saline compounds is very nearly effaced. The difference of dibenzylphosphine from the corresponding terms in the methyl and ethyl series becomes obvious, moreover, in its comportment with oxygen; for whilst dimethyl- and diethyl-phosphine take fire on contact with air at the ordinary temperature, oxygen is without any action even at an elevated temperature on the dibenzylated phosphorus base. As dibenzylphosphine yields no compounds, I was limited to the analysis of the body itself. This analysis led to the formula $C_{14}H_{15}P$. The formation of dibenzylphosphine ensues according to the equation—

$$2C_7H_7Cl + H_3P.HI + ZnO =$$
$$= (C_7H_7)_2HP.HI + ZNCl_2 + H_2O.$$

Benzylphosphine and dibenzylphosphine are not the only phosphoretted products of the action of benzylchloride on phosphonium iodide. The mother-liquor of dibenzylphosphine contains yet another phosphorus body. The thought presented itself that it might be tribenzylphosphine; but notwithstanding many efforts, I have not succeeded in obtaining the compound in a state of purity. The mother-liquor of dibenzyl-phosphine consists, for the greater part, of a viscous substance, soluble in alcohol but insoluble in water, which is precipitated by lead salts. This substance tenaciously adheres to a small quantity of a crystallisable body, which most probably is no other than dibenzylphosphine. All attempts to obtain this glutinous substance (which appears to possess acid properties) in a condition fit for analysis have hitherto failed.

In conclusion I may be allowed most warmly to thank Messrs. F. Hobrecker and E. Niglius for the untiring energy with which they have—the former in the earlier stages, the latter more recently—advanced the progress of these researches.

ON A RELATION BETWEEN THE SURFACE-TENSION OF LIQUIDS AND THE SUPERSATURATION OF SALINE SOLUTIONS.*

By CHARLES TOMLINSON, F.R.S., and G. VAN DER MENSBRUGGHE.

It was stated by one of us in Part II.† that when a drop of a liquid is deposited on the surface of a supersaturated saline solution, it will do one of three things:—(1) mingle with the solution without any nuclear action; (2) spread out into a film with powerful nuclear action; or (3) assume the form of a lens, without any separation of salt. It was further stated that when a liquid forms a film or a lens, it does so according to the general proposition, that if a drop of a liquid, B, with the surface-tension b, be placed on the surface of another liquid, A, with the surface-tension a, the drop will spread into a film, if $a > b + c$ (c being the tension of the common surface of the liquids A and B); but if, on the contrary, $a = < b + c$, the drop will remain in the form of a lens. Hence, if B spread on A, A will not spread on the surface of B. When the liquids A and B mingle in all proportions, c has no value. The spreading of the drop may also be interfered with by the superficial viscosity of the solution, or the greater or less difficulty in displacing the superficial molecules.

It was also stated that if a greasy smear be made upon the clean interior surface of a flask above the solution, and the flask be inclined so as to bring a portion of the solution against such smear, the liquid does one of two things:—(1) it breaks up into well-defined globules, which roll over the smear without loss of tension, in which case the smear has no nuclear action; or (2) as soon as the solution reaches the smear its edge flattens and becomes ragged, in which case the smear is nuclear and the salt separates.

A glass rod drawn through the hand becomes covered with a smear or film; or the same rod, by exposure to the air, contracts a film by the condensation of floating vapour, or a deposit of film-forming dust, and so is brought into the nuclear condition.

It was further stated that when a lens of oil is resting on the surface of a solution, the flask may be rapidly rotated or briskly shaken, so as to break up the oil-lens into a multitude of minute globules, giving the solution the appearance of an emulsion; but that by repose the solution regains much of its transparency, without any separation of salt; but that if, while the flask is being turned round, a sudden jerk be given to it, so as to flatten some of the globules against the side, the solution instantly becomes solid.

The powerful action of films in putting an end to the state of supersaturation being thus established, it occurred to one of us, who had already succeeded in explaining a number of obscure phenomena on the principle of surface-tension,‡ that that force, properly handled, would suffice to account for most, if not all, the varied phenomena of supersaturation. According to this view, whatever tends greatly to lower the surface-tension of a supersaturated saline solution, causes a separation of salt, and at once puts an end to the condition of supersaturation.

In order to test this view, a large number of experiments have been performed by one of us, during the last six months, consisting of repetitions of former experiments, or of new ones suggested by one or both of us. All these experiments have been performed in the open air at Highgate, near London, the object being to avoid all possible miscarriage from the effects of floating dust in the air of a room. It had been suggested that some of the former results as to the action of films might have been vitiated from this source; and although this does not appear to have been the case, yet it is with much satisfaction that the experimenter refers to the greater facility and certainty with which experiments of this kind are conducted in the open air, as compared with those made in a room. In the open air a gentle wind would sometimes blow over the mouths of the flasks, sufficient to produce a low musical note, without any nuclear action, unless a speck of soot or a small insect were carried into the solution; but in general, in order to prevent evaporation, the flasks were kept covered with watch-glasses or small beakers, except when performing an experiment.

The salt used in the following experiments was sulphate of soda, in large crystals, not effloresced, one of three strengths being adopted as circumstances required, and which will be indicated when necessary, namely, 1 part of salt to 1 of water, 2 parts of salt to 1 of water, and 3 parts of salt to 1 of water. Every solution was first made in a large flask, and filtered boiling into eight or ten small flasks, which were re-boiled, covered with watch-glasses or beakers, and carried on a tray into the open air. The same experiment was repeated on a number of these solutions of the same strength.

The points to which this experimental inquiry tended are included in the four following propositions:—

I.—That a supersaturated saline solution, contained in a catharised flask, will remain liquid so long as its free surface, or the surface in contact with the sides of the flask, does not undergo in one or many points a notable diminution of surface-tension.

II.—That if we deposit on the surface of a supersaturated saline solution a drop of a liquid of feeble tension, it spreads, and crystallisation takes place immediately, or after a short time.

III.—That while a liquid of feeble tension produces crystallisation after a time more or less short, a liquid of considerable contractile force (such as pure water) not acting chemically on the solution, may be brought into contact with it without producing change of state.

IV.—That as a liquid of feeble tension produces crystallisation, so a solid covered more or less with a film of such liquid, produces change of state, either at once, or after a short time.

But before any conclusions could be drawn from the results of experiments as to the relation between the surface-tension of liquids and the state of supersaturation in saline solutions, it was necessary to measure the surface-tension of the solutions of Glauber's salt operated on. Accordingly the following data were determined, *first*, for a solution containing 1 part of salt to 1 of water, and *secondly*, for a solution containing 2 parts of salt to 1 of water. The diameter of the capillary tube was 1·598 m.m.

Specific gravity of the solution 1 salt to 1 water at 17°C. = 1·198.
The capillary height 11 m.m.
The specific gravity of the other solution = 1·289.
The capillary height 8·7 m.m.

These data give, according to the formula $t = \frac{r.\,h.\,d}{2}$ (in which t is the tension, h the height, d the density, and r the radius of the tube), for the superficial tensions of the solutions in question, not a greater value than from 4 to 5·2.

If the state of supersaturation of saline solutions depend on the maintenance of surface-tension, according to the first proposition, any force or substance that produces a notable diminution of such tension will cause the state of supersaturation to cease.

Such a force is heat, while such substances as camphor, benzoic acid, &c., have a marked effect in lowering the superficial tension of water, and in doing so undergo those remarkable gyrations which are so well known.

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* A paper read before the Royal Society.

† *Philosophical Transactions* for 1871, p. 52.

‡ "Sur la Tension superficielle des Liquides," par G. Van der Mensbrugghe, Répétiteur à l'Université de Gand. *Mémoires couronnés par l'Acad. Royale de Belgique*, tome xxxiv., 1869. See also *Phil. Mag.* for Dec., 1869, and Jan., 1870.

And first with respect to heat, applied, not so as to affect the whole solution, but locally so as to raise the temperature at one part or point of the surface, while the other parts remained at the temperature of the atmosphere.

Expt. 1.—Four flasks, each about half full of a supersaturated solution of Glauber's salt (2 salt to 1 water), were exposed to a temperature of 32° F. for an hour. A red-hot poker was then passed down the neck of each flask, and in two of them the hot metal was brought into contact with the surface of the solution so as to raise a volume of vapour. There was no separation of salt in any one case.

Expt. 2.—A solution containing a considerable mass of the seven-atom salt at the bottom of the flask was moved over the flame of a spirit-lamp in a line from the bottom of the flask to the neck, so as to heat one part only of the flask. The only effect was to convert a portion of the surface of the seven-atom salt into the anhydrous; but there was no crystallisation. After some hours the anhydrous portion had again taken up its water of crystallisation.

Expt. 3.—A solution of 2 salt to 1 water that had been in the open air during twenty-four hours was uncovered, and water nearly boiling was dropped upon it. A slight cloudiness came over the solution, but there was no crystallisation. Next day a very weak solution of Glauber's salt nearly boiling was dropped upon the surface with no nuclear action.

Expt. 4.—An eight-ounce globular flask had the globe filled with a solution of 2 salt to 1 water. Solutions of two different strengths, namely 1 salt to 1 water, and 3 salt to 1 water, at a nearly boiling temperature upon it, were dropped, but with no nuclear action.

Expt. 5.—A solution of 1 salt to 1 water had filtered into it a nearly boiling solution of 3 salt to 1 water. The drops descended to the bottom of the flask in beautiful rolling rings, but there was no nuclear action.

Expt. 6.—The neck of a flask was inclined over the flame of a spirit-lamp, so as to boil the upper part of the solution, while the lower part remained cold. Water was driven off in vapour, so as to leave a crust of salt in the neck. This, when the flask was left to itself, gradually absorbed moisture and trickled down, and was also washed down into the solution, but there was no nuclear action either from this or from the heat.

These experiments on the action of heat lead to the conclusion that, however much it may diminish the superficial tension of the solutions, it does not apparently disturb the state of supersaturation. This result may be explained with reference to the feeble tension of the solution (=4), and to the fact that heat locally applied does not greatly diminish it. Moreover, heat tends to oppose crystallisation by increasing the solubility.

Numerous experiments were tried as to the action of newly-sublimed camphor and benzoic acid on the solutions. The flasks containing these bodies floating on the solutions were plugged with cotton-wool and kept for some months, during which time they were repeatedly shaken, but there was no separation of salt. The camphor and benzoic acid formed weak solutions with the supersaturated solutions; but the tension of camphorated water being =4·5, and that of an aqueous solution of benzoic acid falling within the limits 4 and 5·2, the difference in tension is too small to produce a rupture of equilibrium. The same remark applies to a solution of soap and of bicarbonate of soda, which had no nuclear action.

Action of Vapours.—It has been shown by recent researches that the presence of vapours in the air of a room, even in minute quantity, has a marked influence in lowering the tension of water and other liquids, so as to account for the discordant values of various careful measurements of the capillary heights of such liquids. As to the nuclear action of the vapours of certain volatile liquids upon supersaturated saline solutions, many observations had been made by one of us, leading to the conclusion that such vapours are strongly nuclear when they become condensed into the form of films on the surface of the solutions, as when the latter is of a lower temperature than the former. In order to ascertain whether vapours, as such, that is, without forming films, have any nuclear action, the following experiments were contrived. The vapour was presented to the surface of the solution by means of a bit of sponge tied to the end of a glass rod, wetted with the volatile liquid and carefully passed down the neck of each flask, so as to avoid touching the side and bringing the sponge close upon the surface to avoid touching that also.* The sponge was held over the solution several minutes, then carefully withdrawn and the flasks covered, leaving the interior charged with vapour. The liquids used were ether, absolute alcohol, chloroform, bisulphide of carbon, wood-spirit, and benzole. The solutions were of all three strengths, and the temperature from 40° to 47° F. After many hours and even days the flasks had a strong odour of the vapours in question, but there was no separation of salt.

Vapour of camphor was also tried in the following manner:—

Expt. 7.—A quantity of camphor was placed in a small retort, the beak of which, made chemically clean by being heated in the flame of a spirit-lamp, was passed into a flask containing a solution of 2 parts salt to 1 of water. The camphor in the belly of the retort was then boiled so as to produce a powerful jet of vapour upon the surface of the solution. The camphor condensed upon such surface in the form of a fine white powder without any nuclear action.

In this case a portion of the vapour of camphor or of the powder would dissolve in the solution without producing in it a notable diminution of surface-tension. The same remark applies to the other vapours, to the action of solid camphor and benzoic acid, of heat, &c.

So also, as stated in Part II., glycerine mingles with the solution without any nuclear action. Now the surface-tension of glycerine = 4·2, so that it can have no effect in lowering the surface-tension of a solution =4, and does not sufficiently lower the tension of a solution =5·2 to produce a rupture of equilibrium.

It was also stated that bisulphide of carbon $t=3{\cdot}3$ to 3·5, and chloroform=2·98 to 3·12, formed lenses on the surface of the solution, and that on gently agitating the flask they fell to the bottom, where they remained permanently without any nuclear action. Creosote=3, behaves in the same manner. Now, in any one of these cases, the tension $t+c$ must be greater than 4·5, and hence there can be no separation of the salt.

(To be continued).

ON THE EMPLOYMENT OF BROMINE IN ANALYTICAL CHEMISTRY.

By P. WAAGE.

The oxidising agents, which are principally employed to-day in chemical analysis, are nitric acid, chlorate of potassa and hydrochloric acid, and chlorine. Each of these, however, though excellent in some ways, has drawbacks to its general employment.

Among those prominent in the use of nitric acid, is the slowness with which it acts in dilute solutions; the length of time required, even when concentrated, to oxidise sulphur; that it never can be employed in platinum vessels, on account of small quantities of chlorine, which it generally contains, and that it must never come in contact

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* In a few cases the wet sponge did touch the solution for an instant, so as to take up a small portion, which immediately crystallised upon the sponge; but the crystallisation thus produced, not being in contact with the solution, the latter retained its liquid state.

with organic matter, like filter-paper, if a subsequent precipitation of a metallic oxide is desired.

Chlorate of potassa acts only in the presence of somewhat concentrated hydrochloric acid, which, in larger quantities, may, under certain conditions, affect the accuracy of the work. Considerable difficulty is at the same time experienced in driving out the last traces of chlorine by boiling, especially in working with dilute solutions. Undecomposed chlorate of potassa is generally the cause of this difficulty, and addition of more hydrochloric acid will be necessary, which requires subsequent dilution before filtration.

The limit for the use of chlorine water is a narrow one, as it does not contain more than ½ per cent of chlorine. The employment of gas is troublesome, as an apparatus must be arranged for every oxidation.

Bromine, therefore, seems to me to be the oxidising material which, being free from the drawbacks that prevent the general employment of the three above-mentioned substances, deserves a place in qualitative as well as quantitative analysis.

I employ the bromine principally in three forms,—as free bromine, as bromine-water, and as bromine in concentrated hydrochloric acid. Bromine-water, prepared by shaking an excess of bromine with water, contains between 2 and 3 per cent of bromine. Concentrated hydrochloric acid, treated in the same way, furnishes a solution containing about 13 per cent of bromine. In choosing for each case the oxidising material as to quantity and concentration, an excess may be easily avoided, and the prominent odour and colour of bromine furnish the best means to recognise an excess, which can be driven off easily by boiling, on account of the low boiling-point of bromine. Bromine-water attacks platinum neither in alkaline nor acid solutions, if the latter are free from nitric acid, and it is—in this shape or dissolved in hydrochloric acid—without action on paper, so that a metallic sulphide may be dissolved and oxidised in presence of the filter-paper by means of bromine, when the oxide can be completely precipitated by potassa or ammonia.

I have employed bromine most advantageously for the oxidation of sulphur, sulphydric acid, and metallic sulphides. For two and a half years it has been my solvent for sulphur, magnetic pyrites, copper pyrites, mispickel. nickel mattes, and precipitated sulphides, both for the determination of sulphuric acid and the metals.

Sulphur, shaken with bromine and water, is easily converted into bromohydric and sulphuric acids, if for every atom of sulphur 3 of bromine are present, or 15 by weight of bromine to 1 of sulphur. If sulphur has to be determined in this way, it is best to add all the bromine at once, so that no sulphide of bromine can be formed.

In the treatment of pyrites no necessity will exist for pulverising them very finely, as they are oxidised by bromine quite easily even in larger pieces, but it is best to add water first, and then bromine with constant stirring, that the action may not become too violent.

Bromine-water is the most convenient material for the destruction of hydrosulphuric acid. A few drops of it added to a filtrate from a metallic sulphide will immediately produce a separation of sulphur, which will as quickly be dissolved by a further addition of a few drops of bromine-water.

In dissolving precipitated metallic sulphides I proceed in the following manner:—I perforate the filter-paper, and wash as much of the precipitate as possible into a beaker. I then pour some of the bromine gas into the funnel, and cover the latter with a watch-glass, when after a few minutes the rest of the sulphide may be washed into the same beaker, and a further addition of bromine-water readily oxidises the rest of the sulphide. I thus get rid altogether of the trouble of burning the filter-paper.

Bromine liberates nitrogen in contact with ammonia, and can therefore not be employed as an oxidising agent in an ammoniacal solution. Ammonia may therefore with advantage be used to destroy an excess of bromine. Ammoniacal salts sometimes prevent the development of the oxidising property of bromine, so that the peroxides of cobalt, nickel, and manganese cannot be formed under these conditions; iron, tin, and mercury salts will, however, be easily converted into the higher oxides in acid solutions, though they contain ammoniacal salts.

Bromine, as it usually occurs in commerce, is not pure, but contains a substance which seems to be caoutchouc, from which it must be freed by distillation in an apparatus which does not have any caoutchouc connections.—*Fresenius's Zeitschrift.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 6th, 1872.

IN the absence of the President the Chair was taken by DR. GILBERT, F.R.S., Vice-President.

The minutes of the previous meeting having been read and confirmed, Messrs. J. Vincent Taylor and W. J. Wilson were formally admitted Fellows of the Society. The name of Mr. A. Liversidge was then read for the first time: for the third time—Messrs. George Elliott Barker, H. A. Smith, Richard Hayton Davies, Francis Henry de Rheims, jun., and Richard Weaver, who were then ballotted for and duly elected.

The first paper read by the Secretary was "*On a Remarkable Salt deposited from the Mother-Liquors obtained in the Manufacture of Soda,*" by T. E. THORPE. This salt, which occurs in the highly-concentrated mother-liquors obtained in the manufacture of soda by Leblanc's process, has been shown by Rammelsberg to contain sodium phosphate, and by Baumgarten to contain fluorine, so that it must be regarded as a double salt analogous to fluorapatite. The crystals, which are distinctly octahedral, have a ruby-red colour, caused by some substance irregularly distributed through them: this the author believes to be phosphate of iron. By solution in water and re-crystallisation they were obtained colourless, a small quantity of sulphide and phosphate of iron being separated. An analysis showed that they have the composition $2Na_3PO_4+NaF+19H_2O$, and that they contain traces of vanadic acid.

"*On the Composition of Ceylon Jargons,*" by M. H. COCHRAN. The author has analysed seven specimens of jargon and zircon, from different localities, adopting for this purpose the process employed by Forbes, but in no instance did he obtain indications of the presence of jargonia.

"*On a Double Sulphide of Gold and Silver,*" by M. M. PATTISON MUIR. This compound, which has already been described in our pages, was obtained during some experiments made in New Zealand by Messrs. J. M. Muir and W. Carrick, with the object of separating the silver from the native alloy of gold and silver. Sulphur was passed through the molten alloy, covered with a film of borax, and was by this means raised from 654 to 812 by assay. The comparatively fusible sulphide, which has much the appearance of native sulphide of antimony, is extremely brittle, and has a specific gravity of 8·159. By heating in a current of air it remains undecomposed: hot strong sulphuric acid, however, removes all the silver, leaving metallic gold in a finely divided state. The results of the analysis correspond to the formula $2(Au_2S_3)5(Ag_2S)$.

"*On the Solvent Action of various Saline Solutions upon Lead,*" by the same author. From the well-known fact that the presence of certain salts in water greatly diminishes this action on lead, and as lead is largely used for cisterns and water-pipes, the author determined to accurately investigate the effect of various saline solutions upon lead. Pieces of bright lead, having a known area, were therefore suspended in these solutions for various periods of time, and the amount of lead dissolved estimated by Wanklyn and Chapman's colour-test. The results are given in a tabular form, from which it would appear that solutions containing nitrates, and especially ammonium nitrate, exert the greatest solvent power, whilst the carbonates have the greatest protecting power, and next to them the sulphates, so that a water containing the latter —even if a considerable amount of nitrates be present— has not a very marked solvent action on lead.

Mr. W. Thorpe, in reply to a question from the Chairman, said he had not examined the action of the Loch Katrine water on lead; but as the action of waters on tarnished lead was known to be but small compared with their action on bright lead, the paper just read was merely of theoretical interest, for, practically, potable waters only came in contact with tarnished lead.

"*On the Magnetic Sand of Mount Etna*," by J. B. Hannay. This sand, which exists in immense quantities on all sides of Mount Etna, has a specific gravity of 2·813, and is scarcely acted on by acids. The results of its analysis gave—Silica, 52·71; magnetic oxide of iron, 19·44; alumina, 19·09; lime, 6·61; and magnesia, 1·85.

"*New Tests for some Organic Fluids*," by J. A. Wanklyn. The author has found that the differential action of potassic hydrate and potassium permanganate may serve as a method to distinguish between various animal fluids. When these are evaporated down with excess of potassa solution, and then maintained for some time at 150°, a certain fixed proportion of ammonia is evolved, and if the residue be now boiled with an alkaline solution of potassium permanganate, a further definite quantity of ammonia is given off, the relative amount of ammonia evolved by these two actions being constant for the same animal fluid. The author has examined, by this method, urine, milk, blood, white of egg, and gelatine, the latter of which gives but a mere trace of ammonia by treatment with caustic potash. The quantitative results are given in a table. It would be possible by this process to distinguish between a spot of milk and one of white of egg on a cambric handkerchief.

"*Dendritic Spots on Paper*," by A. Liversidge. Minute dendritic marks are frequently noticed on paper, to which various observers have assigned a vegetable origin: the author, however, has distinctly proved them to be inorganic. As it was not possibie to obtain a sufficient quantity for complete chemical analysis, a blowpipe examination was made, supplemented by certain special tests. The results showed that the markings consist essentially of sulphide of copper. These dendritic spots have usually a nucleus, which on examination will be found to consist of a minute particle of copper or brass, probably derived from some part of the machinery used in the manufacture of the paper. Other dendritic growths of an organic nature are occasionally found on paper, but they cannot well be mistaken for those described.

Dr. Muller said he had long ago observed these dendritic marks, and knew them to be caused by portions of bronze detached from the paper-making machinery.

Mr. Friswell and Mr. Spiller said they had both noticed similar dendritic markings on prepared albumenised paper and which were caused by the reduction of silver by metallic particles in the paper.

"*On Chinoline and Leucoline*," by C. Greville Williams, F.R.S. M. Ballo has recently stated in a paper "On Leucoline Oil and the Pure Napthaline of Commerce" that he obtained a copious precipitate by treating sulphate of leucoline with potassium chromate, and that by the action of amyl iodide, he obtained a violet colouring matter apparently identical with chinoline blue; but the author had always found that, although chinoline forms a crystalline salt of great beauty with chromic acid, pure leucoline gives only a yellow oily precipitate, and, moreover, by the action of amyl iodide, leucoline yields only a faint, dirty purplish colouration, having no resemblance to chinoline blue. The diversity of these results, and also those of Hofmann, would be explained if coal-tar sometimes contained chinoline as well as leucoline. In order to settle this point, the author proposes to make comparative experiments with leucoline obtained from various sources.

A letter was then read by the secretary from Mr. Dewar, of Edinburgh, in which he mentioned that by the oxidation of chinoline he had obtained two new crystailine acids, one of which is mono-carbo-chinolic acid, C_9H_6N,CO_2H. Its potassium salt, when treated with lime, yields pyrrol along with the lower bases, which induces the writer to believe that chinoline is related to pyrrol and indol.

Dr. C. R. A. Wright next read a paper on the "*Action of Phosphoric Acid on Morphine*." This action is somewhat similar to that on codeine, the polymerides being, however, at the same time, converted into "apo" derivatives by the removal of water. The mixed apo bases are immediately precipitated by sodium carbonate from the acid solution, and can in this way be separated from the unaltered morphine. This precipitate contains a small quantity of a base soluble in ether, which appears to be apomorphine, whose formula, according to the author's researches, should be $C_{68}H_{68}N_4O_8$. The portion of the precipitate insoluble in ether, when dissolved in hydrochloric acid, and fractionally precipitated, yields diapotetramorphine $C_{136}H_{148}N_8O_{22}$, which oxidises with great readiness. On dissolving this in strong hydrochloric acid, and evaporating, a tarry residue is obtained soluble in water. Strong hydrochloric acid precipitates from this solution the hydrochloride of a new base, $C_{136}H_{146}Cl_2N_8O_{20}.8HCl$, which differs from chloro-tetramorphine by $-H_4O_4$. Diapo-tetramorphine, when treated with hydriodic acid and phosphorus, yields the corresponding iodine compound $C_{136}H_{146}I_2N_8O_{20}.8HI$. From these results it would appear that the action of phosphoric acid on morphine is analogous to that on codeine, with the difference that the elements of water are abstracted from the products in the first case, but not in the latter. With respect to the physiological action of diapo-tetramorphine, it is quite as energetic an emetic as apomorphine.

A "*Note on a Secondary Colouring Matter Produced in the Preparation of Alizarine from Anthracene*" was then read by the author, W. H. Perkin, F.R.S., in which he mentioned that he had carefully examined the secondary colouring matter mentioned in his paper on artificial alizarine formerly communicated to the Society. It is soluble difficultly in most liquids, crystallising from glacial acetic acid in minute masses of a yellow colour. Its formula $C_{14}H_8O_5$ is the same as that assigned to purpurine, but it differs from the latter in its reactions; its ethereal solution does not give the characteristic bands of purpurine, and it dissolves in alkalies with a violet colour and not a red. It also differs from alizarine in its reactions, so that it must be considered as quite distinct both from alizarine and purpurine.

"*On the Effects of Temperature on the Absorption of Gases by Charcoal*," by J. Hunter, M.A. This paper contains an account of the effects of variation of temperature on the amount of ammonia and cyanogen absorbed by cocoa-nut charcoal. In the case of ammonia it would seem that the amount of the gas absorbed by the charcoal continuously decreases as the temperature rises from 0° to 55°, but at that point a sudden change occurs, and the amount of gas given off becomes considerably diminished. In the case of cyanogen the absorption takes place very rapidly, being confined almost entirely to the first ten minutes, and the curve representing the absorption between 0° and 80° is continuous. The results obtained are given in tables, and also represented by absorption curves. Hydrogen and nitrogen are very slightly absorbed by the charcoal.

Dr. Armstrong then read a series of communications from the Laboratory of the London Institution: "*V. On the Nitration Products of the Dibromophenol-sulphonic Acids*;" "*VI. On Bromophenol-sulphonic Acid*;" "*VII. On the Formation of Substituted Nitrophenol-sulphonic Acids*." The experiments described in the first of these papers, which have been carried out in conjunction with Mr. F. Brown, are a repetition in the bromo series of those already made by him in the chloro series, and show that the products obtained are in every respect analogous to them. Thus, by the action of nitric acid in the cold dibromophenol-sulphonic acid, $C_6H_2Br_2OH(SO_3H)$ is converted into *a dibromonitro-phenol*, $C_6H_2Br_2NO_2OH$, melting at 132°, but undergoing decomposition at the same time; a small quantity of *a nitrobromophenol-sulphonic acid*, $C_6H_2BrNO_2OH(SO_3H)$ is simultaneously formed. If the heat evolved during the reaction be allowed to accumulate, however, the product consists mainly of dinitrobromophenol, $C_6H_2(NO_2)_2BrOH$. The latter body is identical with the product of the action of bromine on ordinary dinitrophenol.

In the second communication, Dr. Armstrong describes the preparation of bromophenol-disulphonic acid, $C_6H_2BrOH(SO_3H)_2$, and its conversion by nitric acid into *a* bromonitrophenol-sulphonic acid—

$$C_6H_2BrNO_2OH(SO_3H),$$

and, by the further action of the acid, into dinitrobromophenol, identical with that obtained from dinitrophenol.

In their third paper, Dr. Armstrong and Mr. F. Brown describe the action of iodine, bromine, and chlorine on an alcoholic solution of nitrophenol-sulphonic acid, $C_6H_3NO_2OH(SO_3H)$. By the action of these elements on an aqueous solution of the acid, a diiodo-, dibromo-, or dichloro-nitrophenol is invariably produced, and it does not appear to be possible to isolate any intermediate product; whereas when an alcoholic solution is employed, the reaction is found to consist in the replacement in the sulpho-acid of *one* of hydrogen by an equivalent of iodine, bromine, &c., giving rise to the formation of iodonitrophenol-sulphonic acid, $C_6H_2INO_2OH(SO_3H)$, &c.

The Secretary read a letter from M. E. Maumené, of Paris, thanking the Society for the interest it had testified in his theory at a previous meeting, and to Dr. E. Divers for the illustrations he had given of it. The writer then criticises the hypotheses of substitution and atomicity, "for which many chemists entertain so strange a predilection—strange indeed, for scarcely a day passes without one of them announcing that he has looked for a particular result indicated by these hypotheses, and found *another*;" and at the same time claims for his theory that it "gives the means of *calculating* true chemical actions *a priori*."

The meeting then adjourned until Thursday, June 20th, when Mr. H. Deacon has promised to give a lecture, "On Deacon's Method of Obtaining Chlorine as Illustrating some Principles of Chemical Dynamics."

CORRESPONDENCE.

QUANTITATIVE ESTIMATION OF COPPER BY MEANS OF CYANIDE OF POTASSIUM.

To the Editor of the Chemical News.

Sir,—In your journal of the 7th inst., it is stated that M. Yvon asserts that M. de Lafollyé is not the discoverer of the cyanide of potassium process for the quantitative estimation of copper, and quotes a paper published as far back as 1859, by Buignet. It seems singular that there should be any dispute upon this point, as Mr. Parkes, in one of the numbers of the *Mining Journal* of 1851 announced the discovery, and it has been recognised in England since that time as "Parkes's Process." Some of your readers may recollect that in the first volume of the Chemical News (1860) p. 25, the writer, who had had constant practice in copper assaying, and used the salt in question, gave a full account of its application, and pointed out the metals which did and did not interfere with the desired results.—I am, &c.,

Frederick Field.

9, Belmont Park, Lee, S.E.,
June 10, 1872.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, May 13, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Dissociation of Carbonic Acid by the Action of an Electric Current.—A. Thenard.—The author states that when a slow current of carbonic acid is passed in Houzeau's apparatus for the preparation of ozone, then that gas is decomposed into oxide of carbon and oxygen, which latter is moreover strongly ozonised.

Influence of Pressure upon the Spectrum Rays.—L. Cailletet.

Observations on the Paper of Personne on the Presence of Selenium in French-made Sulphuric Acid.—M. Lamy.

Presence of Selenium in French-made Sulphuric Acid.—A. Scheurer-Kestner.—The contents of this paper and of that preceding it mainly bear upon a question of priority of research, both authors calling attention to papers and memoirs published by them on this subject some years ago. It appears that selenium and thallium are far more frequently met with in all kinds of pyrites than is generally supposed to be the case, and the slime of sulphuric acid chambers is especially the substance wherein these two elements are to be met with.

Detection and Quantitative Estimation of the Combined Carbon in Meteoric Iron.—J. Boussingault.—The author's researches have been made with a view to ascertain whether meteoric iron contains carbon in the same condition of combination as is the case with steel and manufactured iron. For this purpose the analysis (by means of bichloride of mercury) has been made of the meteoric iron of Caille (Alpes-Maritimes, France) and of Lenarto (Hungary). The former was found to contain 0·12 per cent of combined carbon, but the latter neither contains graphite nor combined carbon.

Researches on the Action of the Opium Alkaloids, viz., Morphine, Codeine, Narceine. Thebaine, Narcotine, Papaverine, Meconine, Opianic Acid.—Dr. Bouchut.—It appears that the large number of opium alkaloids may be divided into two classes, viz., active soporific and inert alkaloids; the first-named differ greatly in their energy of action. It further appears that only morphine and codeine are active alkaloids, and the latter far less so than the former; narceine, when very pure, is a feeble soporific; but papaverine, narcotine, thebaine, meconine, and opianic acid, are—in pure state—inert substances.

Chloral Sulphydrate (Sulphuret of Chloral).—H. Byasson.—By causing sulphuretted hydrogen to act for about 24 hours upon anhydrous chloral, there is produced a new compound,—a white solid body, emitting a very disagreeable smell, and tasting somewhat like hydrate of chloral, soluble in ether, absolute alcohol, chloroform, and crystallising from these solutions. This substance fuses at 77° and boils at 123°; it volatilises like camphor, and its vapours blacken paper impregnated with solutions of lead salts: in contact with water the sulphuret of chloral is slowly decomposed, with deposition of sulphur, evolution of sulphuretted hydrogen, and formation of hydrochloric acid and hydrate of chloral, which remain dissolved in the water; by the action of solutions of hydrated alkalies and ammonia, sulphuret of chloral is very rapidly decomposed, chloroform being formed, and alkaline sulphurets and chloride, as well as formiate of the same base; nitric acid rapidly and very energetically decomposes the body alluded to, the result being the formation of sulphuric and trichloracetic acids; the formula of the sulphuret of chloral is—$C_4HCl_3O_2,2HS$.

Expansion of Moist Gases.—M. Amagat.—The following conclusions can be drawn from the author's researches:—Unless gases are thoroughly well dried, the expansion of the same is increased far less by the presence of aqueous vapour than has been supposed by some *savants*, who have attributed to the presence of aqueous vapour the differences which exist between the coefficients of dilatation of the different gases; that it is absolutely impossible to base a method of hygrometry (estimation of the degree of moisture in air) upon the variation of the coefficient of expansion of the air as due to moisture, since that variation is difficultly appreciable even for very great divergences of the quantity of moisture present in the air.

May 20, 1872.

In addition to several important papers and memoirs relating to geology, mineralogy, astronomy, meteorology, and natural history, this number contains the following paper relating to chemistry:—

Mineralogical Study on Grey-coloured Serpentine.—S. Meunier.—The author has examined ten different samples of serpentine, obtained from different countries. It appears that the average composition of this rock in 100 parts is—Silica, 39·90; magnesia, 38·10; alumina, 1·25; lime, 2·0; protoxide of iron, 6·42; water, 11·60. Mineralogically grey-coloured serpentine consists of magnetite, pyroxen, peridote, and magnesite.

Bulletin de la Societe Chimique de Paris, No. 1, January 1, 1872.

From the *procès-verbaux* of the meetings of this Society, we quote the following particulars:—

Preservation of Dilute Hydrocyanic Acid.—M. Petit.—The author finds that the acid diluted to one-tenth deteriorates very rapidly, while an acid diluted to one-thousandth keeps unaltered for several months; and an acid at one-tenth which already exhibits a marked alteration is preserved from further decay on being diluted to one-thousandth: it does not appear that the presence of ammonia provokes the alteration.

An Isomer of Anthraquinon.—Dr. Schutzenberger.—While repeating the experiments of Graebe and Liebermann, the author has discovered an isomer of anthraquinon, a sublimable body, crystalline, beautifully red-coloured, and much resembling alizarine, from which it is distinguished by its insolubility in potassa and ammonia: when the vapour of this substance is heated to 300° it is converted into ordinary anthraquinon.

Phosphorus and Iodoform.—M. Gautier.—When the substances alluded to react upon each other there is formed a yellowish-orange-coloured body, insoluble in almost all solvents, and yielding—when treated with boiling water—first a more bright-coloured compound, and next products of the decomposition of teriodide of phosphorus, which last-named body does not at 250° act upon chloroform.

Action of Sulphuric Acid upon Cellulose.—M. Terreil.—The cellulose is first steeped into a 1 per cent solution of iodide of potassium, and, after drying, is put into concentrated sulphuric acid, and then washed with water, whereby the cellulose becomes blue-coloured. This product does not at all resemble iodide of starch, because, when inspected by the microscope, it will be found to consist of red- and of blue-coloured globules.

This number further contains the following original memoirs and papers:—

Method of Separation of Two Isomeric Toluidines.—Dr. Rosenstiehl.—This lengthy essay is divided into the following sections:—Analytic separation; estimation of toluidine; preparation of pseudotoluidine; method of supersaturation; method based upon the different solubility of the oxalates in water; method based upon fractioned saturation.

Chemical Research on the Crystalline Substance met with on Vanilla.—P. Carles.—After briefly referring to the researches made by other scientific chemists on this substance, and pointing out that the great discrepancies of the results lead to the surmise that the same substance has not always been investigated, the author states that he operated upon the crystals which are usually deposited in the tin canisters in which vanilla is kept. The purified material is an acid termed vanilic acid; it fuses at about 81°, sublimable when heated on platinum foil, very readily soluble in alcohol, ether, chloroform, sulphide of carbon, and in fixed and volatile oils; water at 15° dissolves only 1·2 per cent of this acid, but in boiling water it is readily soluble; mineral acids decompose it, and it yields substitution products with chlorine, bromine, and iodine; vanilic acid colours salts of iron blue, reduces nitrate of silver, and yields an abundant precipitate with acetate of lead. The formula of this acid is $C_{16}H_8O_6$. The author describes, at great length, a number of its salts and some of its substitution products; by fusion with caustic potassa, it yields oxyvanilic acid, $C_{16}H_8O_8$; it is isomeric with anisic, formobenzoylic, methylsalicilic, and a series of other acids.

Production of Cymen by means of the Hydrate of the Oil (Essence) of Turpentine.—P. Barbier.—The hydrate of the oil of turpentine (terpine), $C_{20}H_{16}2H_2O_2$, has been treated with bromine, yielding a thickish liquid—an unstable compound—which, on being acted upon by caustic potassa, is found to consist of a bibromated and tribromated compound, both free from oxygen: by heating these substances cymen is obtained, in all respects akin to the cymen of camphor, viz., a colourless, very fluid liquid, of a lemon-like odour, sp. gr. at 15°=0·864.

No. 2, January 15, 1872.

This number does not contain any original papers or memoirs.

No. 3, February 1, 1872.

New Isopropylic Ethers.—M. Silva.—The formiate is obtained by heating iodide of isopropyl with formiate of copper to 120°: this ether boils at from 65° to 67° under pressure (barometer reading) of 749 m.m. The lactate of mono-isopropylic ether has been prepared by heating—in a sealed tube—to 170°. Lactic acid and isopropylic alcohol:—this ether is soluble in water, and boils at from 166° to 168°; the di-isopropylic lactate is obtained from the former by treatment first with sodium, and next with iodide of isopropyl. The resulting ether is soluble in water, and has a very high boiling-point; the cyanate of isopropyl is a liquid which boils at 74·5°, and has a vapour density of 2·943.

This number further contains the following original papers:—

Ammoniacal Platinum Bases.—P. F. Clève.—The third instalment of a lengthy monograph on this subject, divided into the following sections:—Platinamine—

$$R=Pt''''\begin{cases}NH_3\\NH_3\end{cases}$$

bromide, iodide, basic nitrate, nitrated nitrate (*azotate nitré*), nitrated and chlorated nitrate, bichlorated nitrite, bichlorated nitrite and nitrite of silver, terchlorated nitrite, bromated nitrite, sulphate, basic sulphate, oxalate, and hydrate, of this base. Platino-semidiamine—

$$R=Pt''''\{NH_3.NH_3,$$

chloride, polyiodide, nitrate, chlorated nitrite, bromated nitrite, basic monochlorated nitrite, sulphate, of this base. Platinum monodiamine—

$$R=Pt''''\begin{cases}2NH_3\\NH_3\end{cases}$$

chloride, nitrate, bromated nitrate, basic monobromated nitrate, bromated sulphate, of this base. Diplato-semidiamine—

$$Pt_2''\begin{cases}2NH_3.OH\\2NH_3\,OH\end{cases}+H_2O$$

hydrate, chloride, nitrate, sulphate, of this base.

Volumetrical Estimation of Zinc.—A. Hénniger.—The author describes a process of estimating zinc by means of sulphide of sodium, the zinc being in ammoniacal solution. In order to test for the presence of a slight excess of the sulphide, the author recommends, as the most sensitive substance, that kind of so-called enamelled *carte-de-visite* paper which owes its brilliant whiteness to carbonate of lead (white-lead) forced into the pores of the paper by hot-pressing: it is clear that, when operating on zinc ores, the other metals accompanying the zinc have first to be removed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 8, 1872.

This number contains the following original papers and memoirs:—

Solubility of Sugar in Mixtures of Water and Alcohol, at Different Degrees of Concentration and at Varying Temperatures.—C. Scheibler.—This excellent monograph, elucidated by a series of lengthy tabulated forms, and by a lithographic print exhibiting results of experiments, is not well suited for any useful abstraction.

Action of Permanganate of Potassa upon Tartaric Acid.—A. Fleischer.—After first referring to the researches of Péan de St. Gilles on this subject, the author describes the results of a series of experiments made with and without the addition of a mineral acid to the tartaric acid solution to which a permanganate solution is added. It was found that, when no mineral acid is added, there is formed a certain amount of a tartrate of protoxide of manganese—

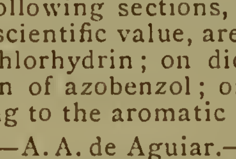
$$C_4H_4MnO_6,2H_2O.$$

This salt is soluble in tartaric and mineral acids, insoluble in alcohol oxalic acid solution, treated in a similar manner with permanganate, yields oxalate of protoxide of manganese; citric acid, when treated with permanganate solution only, is also partly decomposed, but no salt akin to those just alluded to is formed.

Communications from the Chemical Laboratory of the University at Freiburg, in Breisgau (Baden).—A. Claus.—This paper is divided into the following sections, the contents of which, notwithstanding their high scientific value, are not well suited for any useful abstraction:—On dichlorhydrin; on dichlorglycid; on carbothialdin; on the preparation of azobenzol; on azophenylen, a new nitrogen compound belonging to the aromatic series.

On Nitro-naphthalins.—A. A. de Aguiar.—This essay, illustrated by woodcuts exhibiting crystallographical figures, treats at length on the nitro-compounds of naphthalin, viz., mononitro-naphthalin, best prepared by dissolving the naphthalin in very highly concentrated glacial acetic acid, and treating this solution with strong nitric acid, ebullition being resorted to for a few moments; it depends upon the degree of concentration of the nitric acid, and upon the duration of time of its action upon the naphthalin solution, what nitro-compound will be formed; the mononitro-naphthalin is a sulphur-yellow-coloured, prismatically-crystallised body, soluble in alcohol, better still in glacial acetic acid, fusing at 61°, formula $C_{10}H_7(NO_2)$; of dinitro-naphthalin, an α and β compound are distinguished, the formula of each is the same, viz., α and β $C_{10}H_6(NO_2)_2$,—α dinitro-naphthalin fuses at 216°, the β compound at 170°; of trinitro-naphthalin, also an α and β compound are distinguished, formula α and β $C_{10}H_5(NO_2)_3$,—the α compound fuses at 122°, the β at 218°; of tetranitro-naphthalin, likewise an α and β compound are distinguished, the formula for these being—α and β $C_{10}H_4(NO_2)_4$,—the α body melts at 259°, the β at 200°.

Synthesis of Carbazol.—C. Graebe.—After first referring to the communication made by Braun and Greiff (Chemical News, vol. xxv., p. 191), the author states that he obtained carbazol from aniline, by slowly passing that fluid through a very highly-ignited porcelain tube; there are formed by this operation large quantities of hydrogen and ammonia, while cyanide of ammonium is also produced. Carbazol is in this instance produced according to the following formula:—$2C_6H_7N=C_{12}H_9N+H_2+NH_3$. The author states that carbazol is to be viewed as imidodiphenyl, formula—



$$\left.\begin{array}{l}C_6H_4\\|\\C_6H_4\end{array}\right>NH;$$

diphenylamin, when passed through a red-hot tube, also yields carbazol.

Preliminary Communications.—I. Remsen.—The author states that (1) by the reaction of V. Meyer (not further explained), parasulphobenzoic acid is converted into perfectly pure terephthalic acid; (2), when paratoluol sulphamide is oxidised with bichromate of potassa and sulphuric acid, it is converted into an acid, which contains the group SO_2NH_2; this new acid is parasulphamin benzoic acid—

$$C_6H_4\left\{\begin{array}{l}SO_2NH_2\\COOH.\end{array}\right.$$

Products of Iodisation (Iodirung) of the Isomeric Acids $C_7H_6O_3$.—MM. Hlasiwetz and Weselsky.—After first referring to some researches made by the authors some three years ago, relating to the substitution of the hydrogen of phenol by iodine, the authors now state that they have tried this process with great success on the three isomers of the formula $C_7H_6O_3$, whereby it was found, however, that in some cases all—in others only a portion—of the hydrogen was eliminated, this difference being due to the different position occupied by the hydrogen atoms in the organic molecule.

Contribution to the History of the Isocyanuric Acid.—A. Steiner.—Notwithstanding its high scientific value, the contents of this essay are not well suited for any useful abstraction, an observation which also applies to the following memoir.

Determination of the Constitution of Alcohol Radicals by the Oxidation of Aromatic Hydrocarbons.—A. Popoff and T. Zincke.

No. 9, 1872.

This number contains the following original papers and memoirs:—

Nitro-Compounds of the Fatty Series.—V. Meyer and O. Stüber.—The first instalment of a monograph on this subject. This portion is divided into the following sections:—On nitro-ethan; action of iodide of ethyl upon nitrate of silver; action of iron and acetic acid upon nitro-ethan; action of alkalies on nitro-ethan.

Application of Sulphuretted Hydrogen as a Reagent in Researches and Tests made on the Dry Way.—J. Landauer.—The author describes at some length the results of some experiments which led to the discovery that, when a metallic compound is mixed with some pulverised hyposulphite of soda, and then heated upon a bead of borax in the inner blowpipe-flame, then the peculiarly characteristic reactions sulphuretted hydrogen exhibits with metallic solutions are readily brought out. This paper is illustrated with a diagram exhibiting the names of a large number of metallic oxides, their behaviour with $Na_2S_2O_3$ and with a borax bead alone in the oxidising and reduction flames.

Preliminary Observation on the Ready Evolution (Abspaltung) of Hydrocyanic Acid from Nitro- and Dinitro-Benzol and Similar Compounds.—J. Post and H. Hübner.—The authors, after alluding to an observation made as far back as the year 1828 by Dr. Wöhler (*Pogg. Ann.*, xiii., 488), viz., that picric acid yields, by treatment with baryta water, hydrocyanic acid, state that they recently found that even dinitrobenzol, when boiled with caustic soda or potassa solution, becomes decomposed, hydrocyanic acid being evolved, which the authors converted into cyanide of silver and ferrocyanide of iron (*alias* prussian blue). The dinitrobenzol operated upon was perfectly pure; the alkali was prepared from sodium, and, as regards potassa, specially tested for its perfect purity. Mononitrobenzol yields hydrocyanic acid when fused with caustic alkali, and picric acid does the same when boiled with a solution of that substance.

Pentahydrated Sodium-Metasilicate, $Na_2OSiO_2 + 5H_2O$.—T. Petersen.—While visiting a chemical factory, the author obtained from the manager a crystalline substance which had been separated from the mother-liquor of a crude caustic soda lye. The crystals are large-sized, colourless, transparent at first, but become turbid by exposure to air; they fuse readily in their water of crystallisation. After ignition a white bulky mass is left, which is readily soluble again in water. This substance consists, in 100 parts, of—Silica, 28·30; soda, 29·25; water, 42·45. To this paper is added a crystallographical description, illustrated with woodcuts.

Estimation of Uric Acid.—E. Salkowski.—This paper contains a rectification of Schwanert's assertion that the author's (Salkowski) researches on this subject are incorrect, the last-named author pointing out that Schwanert has not read his more extensive memoir published on this subject.

Some Molecular Combinations of Phosphorus-Bromochloride and Bromine.—A. Michaelis.—Notwithstanding the high intrinsic merits of this lengthy memoir, its contents are not well suited for useful abstraction.

Sulpho-Acids of Aniline Blue.—C. Bulk.—This exhaustive monograph is divided into the following sections:—Triphenyl-rosaniline-monosulpho acid, $C_{20}H_{16}(C_6H_5)_2(C_6H_4SO_3H)N_3+H_2O$; triphenyl-rosaniline-disulpho acid; triphenyl-rosaniline-trisulpho acid; triphenyl-rosaniline-tetrasulpho acid; sulpho acids of aniline violet; sulpho acids of ethyl-phenyl-rosaniline.

Researches on the Constitution of the Benzol-Derivatives.—V. von Richter.—The third instalment of an exhaustive memoir on this subject. The author deduces the following classification of the benzol-derivatives from his researches:—

Chinon.	Dinitrobenzol.	Volatile nitrophenol.
Oxybenzoic acid.	Salicylic acid.	Paraoxybenzoic acid.
Phthalic acid	Isophthalic acid.	Terephthalic acid.
(1,2)	(1,3)	(1,4)

Composition of Two Varieties of Crystallised Cast-Iron.—Dr. C. Rammelsberg.—In one of the samples the iron alluded to was derived from a broken rail-rolling cylinder at the Henrichs Works, near Hattingen-on-the-Ruhr (Rhenish Prussia). This iron was crystalline, exhibiting regular octahedrical crystals, sp. gr., 7·285. Electro-negative compounds present in the following quantities, per cent:—Graphite, 1·121; carbon, 1·963; silicium, 1·537; sulphur, 0·113; phosphorus, 0·041. The atomistic relation of these elements to that of the iron is as 1 : 7·6. Sample of iron from the Friesenbruch Works (Nova Scotia), metal also crystalline, sp. gr. 7·617:—Quantity of graphite, a trace; quantity of the following elements, per cent—carbon, 2·820; silicium, 0·334; phosphorus, 0·086; sulphur, 0·000; C, Si, P : Fe = 1 : 7 and P : Si : C = 1 : 4·3 : 84; Si : C = 1 : 19·5.

La Revue Scientifique de la France et de l'Etranger,
May 18, 1872.

This number contains a very exhaustive review of Dr. Berthelot's recently published work:—

Organic Chemistry.—E. Alglave.—This extensive memoir is too concisely written to admit of any useful abstraction, but it appears that the work alluded to, "Traité de Elémentaire de Chimie Organique," is in every respect a standard work that deserves the attention of all scientific chemists.

May 25, 1872.

This number does not contain any original papers relating to chemistry.

Revue Hebdomadaire de Chimie Scientifique et Industrielle,
April 4, 1872.

Description of a Newly-devised Arrangement of Retorts for the Distillation of Bituminous Shales.—M. De Jussieu.—From what is here stated it appears that the arrangement described effects a considerable saving of fuel for heating, while, moreover, the retorts do not require renewal for a very long period of time.

Pulverised Bricks in Lieu of Hydraulic Cement.—C. Mène.—The author states that in Cuba, and other Spanish colonies, there is used, in lieu of hydraulic cement, a mixture, consisting of 1 part of pulverised bricks, 1 part of lime, and 2 parts of sand. These ingredients are well blended together in a dry state, and then made up as mortar is, with water.

Description of a Contrivance for Hermetically Closing Doors so as to prevent Draughts of Air.—M. Challiès.—This description is illustrated by a series of woodcuts. It appears that this contrivance is used with great success in Paris, to prevent draughts of cold air entering rooms, houses, workshops, &c, through the chinks of the doors.

MEETINGS FOR THE WEEK.

Monday, June 17th.—Anthropological, 8.
Tuesday, 18th.—Zoological, 9.
Wednesday, 19th.—Meteorological, 7. (Anniversary).
—— Geological, 8.
Thursday, 20th.—Royal, 8.30.
—— Royal Society Club, 6.
—— Zoological, 4.
—— Chemical, 8. Mr. H. Deacon, "On Deacon's Method of obtaining Chlorine as Illustrating some Principles of Chemical Dynamics."

TO CORRESPONDENTS.

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A. P. S.—Consult work by Dr. Duflos. See "Notes and Queries" column, vol. xxiv., p. 313. See also "Reviews of Works," by same author, vol. xxiii., pp. 81 and 224.

G. P.—Reimann's "Aniline and its Derivatives," edited by W. Crookes, F.R.S., was published some time since by Longmans. Another work on Dyeing will appear in the autumn.

J. M.—The paraffin received was not good. Get a specimen from a respectable operative chemist.

F. M. R.—Papers by Mr. Stanford and others have frequently appeared in our columns. Consult the Index.

E. W. Prevost.—The No. was sent from our office.

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THE FARADAY LECTURE,

DELIVERED BY

PROFESSOR CANNIZZARO

BEFORE THE

MEMBERS OF THE CHEMICAL SOCIETY OF LONDON,
MAY 30, 1872.*

The meeting was held in the Lecture Theatre of the Royal Institution, kindly lent for that purpose; Dr. Frankland, F.R.S., the President of the Society, occupying the Chair.

Dr. Frankland, in introducing Professor Cannizzaro, explained that the lectureship had been founded by the Chemical Society in honour of the illustrious Faraday, to be held by some eminent foreign *savant*, who, during the term of his tenure, was to deliver a discourse before the Society. In 1869 M. Dumas had honoured them with his presence there, and on that night they were to listen to Professor Cannizzaro, of Palermo, who had undertaken to deliver the Faraday lecture. After alluding to the numerous investigations which the Professor had made in organic chemistry, and amongst others the discovery of benzylic alcohol,—the first normal aromatic alcohol that had ever been prepared,—and to the important theoretical views which he had originated, the President, in the name of the Society, presented to him the Faraday medal struck in honour of his visit.

Professor Cannizzaro said, that when he received the flattering invitation to deliver the Faraday lecture he was placed in very unfavourable circumstances to respond to it, as he had no definite results from recent researches to lay before the Society, and was, moreover, on the point of suspending his labours, and abandoning his old laboratory, in order to remove to Rome and establish a new one there. In this difficulty a subject for a discourse fortunately presented itself, and which the celebrated French chemist Dumas, had promised to treat of in 1847,—namely, the form which the theory of chemistry should take at the present time. Although this could not be fully discussed in such a short space of time, it would at least have the advantage of directing the attention of chemists to a question of great importance in the transition stage which our science is at present going through.

In recalling the promise which M. Dumas had made to the Academy of Sciences of Paris, in 1847, to examine the form which theoretical instruction in chemistry should take in the present state of the science, the lecturer proposed to consider in his discourse the limits within which the exposition of general theories should be included in teaching chemistry, and the form that it was desirable that it should assume.

Whilst giving a broad sketch of the progress of modern chemistry, he showed that the atomic theory had become more and more intimately interlaced with the fabric of chemistry, so that it is no longer possible to separate them without rending the tissue, as it were, of the science, and that up to the present time we have been unable to enunciate even the empirical laws of chemical proportion independently of that theory; for those who employ the term "equivalent" in the sense that Wollaston did, commit an anachronism. Consequently, in the exposition of the value and use of symbols, formulæ, and chemical equations, not only are we unable to do without the atomic and molecular theory, but it is even inconvenient to follow the long and fatiguing path of induction which leads up to it. By one of those bold flights of the human mind we can at once reach the height whence we discern, at a glance, the relations between facts.

He then went on to show that the solid basis, the corner-stone of the modern molecular and atomic theory, —the crown of the edifice of which Dalton laid the foundation,—is the theory of Avogadro and Ampère, Kœnig and Clausius, on the constitution of perfect gases, to which chemists, unknown to themselves, have been led in the progress of their science. He thought the time had arrived for reversing the order which had hitherto been followed in teaching chemistry; that instead of setting out from the criteria for determining the weight of the molecules, and then to show their ratio to the vapour densities, they ought, on the contrary, to commence with the latter, with the theory of Avogadro and Clausius, demonstrating it from physical considerations; to found upon that the proof of the divisibility of simple bodies, that is to say, the existence of atoms; and to show, as occasion presented itself, that the weights of the molecules, and the numbers of the atoms deduced by the application of this theory, are in accordance with those which are deduced from chemical criteria. By this means we can measure the degree of confidence to be placed in the latter criteria, since so-called compound equivalents do not suffice to determine the weight of molecules, or even to prove their existence. They may, however, be deduced from a single principle—the theory of the constitution of gases: this is the natural transition from physics to chemistry.

The Professor then stated, in detail, how he applied the principles he had laid before them. He introduced his pupils to the study of chemistry, in endeavouring to place them on the same level as the contemporaries of Lavoisier, and to teach them to appreciate the importance of the principle of the conservation of the weight of matter, showing them that this is quite independent of any idea of its nature or constitution. They are thus led to examine the ponderable composition of substances, so that the student passes rapidly from the epoch of Lavoisier to that of Proust, and then to that of Berzelius at the time when he commenced his researches on proportions. At this stage the same impulse is given to the pupil as Berzelius received on becoming acquainted with the hypothesis of Dalton. The latter is laid before him without any accessory, the use of symbols and formulæ being introduced dogmatically. There will now arise in his mind the same doubts and difficulties that assailed Berthollet, Sir Humphrey Davy, and Wollaston, in the application of Dalton's theory, and, at the same time, a desire for an explanation of the simple relation which exists between the vapour-volumes of bodies which react on one another, and of the products which are obtained. Now is the moment to state or recall to mind the physical theory on the constitution of the perfect gases, commencing with a rapid glance at their general and special characters. He insisted that in this part of the instruction the mind of the student should not be diverted from the numbers expressing their relations, by any considerations of the variations caused by changes of temperature and pressure. In applying the theory of the constitution of gases, it will be perceived that the molecules of simple bodies are not always the atoms of Dalton, and a certain confusion will thus be produced in the mind of the beginner in the conception of the ideas of atoms and molecules. The hypothesis of Dalton can now be laid aside, substituting, as a starting-point, the theory of the relation of molecular weights to the vapour densities. A table must be prepared of the vapour densities compared with that of hydrogen as 2, that is to say, the weights of their molecules compared with the weight of the semi-molecule of hydrogen taken as unity. We must then compare the composition of the molecules containing the same element,—including, or not, the molecule of the element itself,—and thence deduce the law of the existence

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* Abstract.

of atoms, that is to say, the amount of each element which always enters, by whole multiples, into the molecules which contain them. We here have the atoms of Dalton, which, in the present state of the science, express not only all that Dalton discovered, but also the composition of equal volumes of their vapours, and in the choice of which those doubts can no longer arise which embarrassed Davy and Wollaston. The ideas of molecules and atoms suggested to the student by this law are devoid of all considerations of form, size, continuity, or discontinuity; the only property indissolubly connected with them is that of ponderability—the very definition of matter.

Recollecting that no physical theory of the constitution of matter had yet been advanced which thoroughly conformed to chemical ideas, he insisted upon the advisability, in teaching the molecular and atomic theory, to keep it free from all that is not absolutely essential, so that it may preserve sufficient plasticity to adapt itself to the progress of our physical and mathematical knowledge. For this purpose he thought it useful to allow the student, in the first place, to glance at the changes in the hypothesis of the constitution of matter, and then to cause him to estimate the degree of confidence it merits in the actual state of our knowledge. Having thus placed upon a solid basis the fundamental notions of atoms and molecules, by the comparison of the composition of equal volumes of the bodies in the gaseous state, it becomes necessary to consider the difficulties which arise in the application of these notions when the vapour densities are wanting: he explained and justified the use of the various auxiliary criteria to which we have recourse in these cases, proving them, in the first instance, by the touchstone of the theory of Avogadro and Clausius, by showing that they gave results in accordance with that theory whenever the two methods can be employed simultaneously.

He believed that we should never lose sight of the starting-point, nor give the formulæ of all compounds as of equal probability. "It is not by concealing the obscurity of these questions that we shall enlighten the student; on the contrary, we should estimate each fact at its true value, by showing him that our science does not merit an equal degree of confidence on all points." This forms the introduction, the preparation for the study of the transformations which matter undergoes—the real object and aim of our science.

The comparison of the atomic composition of molecules has led chemists to the law of substitution, to the theory of types of Dumas, then to that of Williamson and Gerhardt, and, lastly, to the theory of the different valency of atoms and their modes of union, or the so-called theory of atomicity which includes the former. Although at present it is impossible, in teaching chemistry, entirely to eliminate this latter theory, which gives a summary of several laws, and guides us ordinarily in the co-ordination—and even prevision—of a large number of facts, yet it is difficult to keep it within just bounds, so as to avoid infusing into the mind of the beginner illusions which are dangerous for their intellectual education. In order to avoid this, it is advisable to bear in mind the progress of this doctrine, and the actual phase of development which it has at present reached. It is still far from being a complete and well-established theory, but is in a state of transition, for although, doubtless, it embraces a large number of facts, as yet it does not embrace them all. It is only a partial representation of the reality, and that from a restricted point of view, showing but little relation to our views of the constitution of matter, for it is the result of a comparison of diverse facts expressed by means of the atomic and molecular theory. It is convenient, therefore, to consider each part of this doctrine exclusively in relation to the group of facts which has suggested it.

It is unadvisable to define the valency of atoms as a property inherent in them, and then to deduce as a corollary their different modes of union; on the contrary, it is preferable to regard each portion of this doctrine as a deduction from the observation and comparison of a determinate group of facts, until an opportunity offers to unite these fragments into one whole, not forgetting, however, to notice the gaps which exist,—never going beyond what the facts themselves suggest, and never applying to all bodies indiscriminately the laws which suit only a single group. For instance, we must not pass over in silence the fact, that whilst certain elements are bi-, tetra-, or even hexa-valent, others are tri- and penta-valent; but the pupil should be prevented from acquiring mechanical and geometrical ideas of the cause and effects of the valency of atoms, by frequently reminding him that chemical facts show nothing about the size, form, continuity, or relative position of atoms. If we are sometimes obliged to employ the expression, "relative position of atoms in the molecules," and even to represent them graphically, we must warn the student that these are only artifices to express certain transformations, and that we are really ignorant of the relative position of the atoms, either in space or in the mutual action of different portions of matter. With these reservations it is possible, in teaching, to derive considerable advantage from the theory of atomicity, and at the same time avoid its inconveniences.

In the study of the transformations which matter undergoes, we should direct the pupil's attention not only to the ponderable changes in the composition of molecules, but also to the electrical and calorific phenomena which accompany these transformations. Even from Lavoisier's time, it has been recognised that we cannot separate the study of matter from thermic considerations, and every day the connection which exists between chemical and thermic phenomena becomes more apparent.

As in the study of ponderable changes we were guided by the law of the conservation of weight, so in the connection between chemical and dynamical phenomena, we are guided by the law of the conservation of force, the two studies mutually supplementing and illustrating one another. Not only will the atomic and molecular theory and that of atomicity help us to compare dynamical phenomena, but the study of dynamical phenomena will show us analogies and differences between chemical actions which would not be observed in the ponderable equations. We should, therefore, instruct the student in the little definite knowledge which we at present possess concerning thermic and electric phenomena, and especially fix in his mind the fundamental notion of a mechanical equivalent, and the manner of comparing it with chemical action as expressed by the atomic theory. In this we should be aided by the previous or simultaneous instruction of the student in physics under the form and language of the thermo-dynamic theory.

The lecturer concluded by observing that in the choice of methods and of matter for a course of chemistry, it should always be borne in mind that it was eminently a progressive science, and that, even at the time of its most rapid development. The student should start not only with a knowledge of certain definite and fixed principles, but with an aptitude, and sufficient preparation to enable him to follow the science in its unceasing transformation and progress, whether he intends to expressly cultivate chemistry, or has only learnt the elements of the science as an auxiliary to other studies or professions. Moreover, the end of chemical instruction for both these classes of students is not only to fix in their memory a certain amount of knowledge, but to assist in their intellectual education. For this, chemistry, of all sciences, is one of the best, offering, both in verbal and practical instruction, excellent occasions for the exercise and harmonious development of all the faculties of the human mind.

He had desired to call attention to what he considered to be the most efficient means of imparting a knowledge of chemistry, so that it might serve as an instrument of intellectual education, and that the student, by following it in its ulterior developments, might judiciously apply it to the study of the other branches of natural science. If the attention of the eminent chemists and professors there present were once attracted to this subject, he felt certain that a bright light would be thrown on it, and that our young professors would find numerous suggestions to direct them in teaching chemistry, and that at the very moment when instruction in our science had become so difficult on account of the rapid transformation which it was undergoing.

Dr. **Williamson** said that those who were present ought not to separate without some expression of the pleasure that they had felt in listening to so learned, vast, and eloquent a discourse, treating as it did of a most difficult and important problem. There was scarcely anything of greater moment in the scientific education of youth than the rightly setting before them those wonderful transformations of matter which it is the province of chemistry to explain. These great and growing truths,—for, as the lecturer had said, they were growing truths,—should be set before youth in such a manner as to form a coherent whole. He hoped to study this masterly discourse with profit and delight, and would now propose a vote of thanks to his illustrious colleague for the honour which he had done them in delivering to them the Faraday lecture.

Professor **Tyndall** said he had heard the discourse with deep interest, for it showed that the lecturer knew the importance of a teacher's vocation, and that his province was not merely to communicate knowledge, but to do it in such a manner as to arouse an interest in, and love of, the subject in the pupil by preserving it in its proper relations. He would have welcomed the lecturer to that Institution even had he come to tear in pieces the notions which he cherished regarding atoms and molecules; how pleasant it was, then, to find such a broad agreement between their views. The chemist cannot halt at equivalent proportions: he *must* ask himself whence they arise, and the inevitable answer is some form of the atomic theory. This theory, however, cannot be confined to chemical phenomena: the motions of those atoms and molecules underlie all our explanations of the physical cause of light and heat, and they are already taking up the field of magnetism and electricity. Consider, for example, the heat of gases, both as regards the motion of translation of the molecules which produce temperature, and the motions of rotation and vibration of their constituent atoms, which, though they do not express themselves as temperature, constitute a portion of the heat. Clausius has shown that, even in the simplest gases, nearly two-fifths of the whole heat is due to these internal motions; whilst in gases of complex molecular constitution, which condense on combining, the ratio of the total heat to the heat of temperature is still greater. The experiments of Regnault, which show that the specific heat of a perfect gas at a constant volume is constant, proves, as Clausius has shown, that the one kind of motion is proportional to the others. The lecturer had also referred to atoms of the same kind combining together, so that free oxygen and free hydrogen, being considered as composed of molecules each containing a pair of atoms, has certainly simplified the results. But it must not be forgotten that this combination of like atoms is generally different from that of unlike atoms. The union of oxygen with oxygen, or nitrogen with nitrogen, produces no such effects upon the luminiferous ether as the union of oxygen with nitrogen. With the same quantity of matter, the amount of *vis viva* sent forth as radiant heat may be augmented a thousand-fold, perhaps a million-fold, by the act of diverse combination. This act seems to carry with it a condensation of the ether to a dense atmosphere around the atoms. Had a cannon the power of gathering round itself a dense atmosphere, it would send forth a greater amount of *vis viva* as sound. A gun fired at Chamouni may be heard upon Mont Blanc, while the same gun fired on Mont Blanc may not be heard at Chamouni, because the air in which the concussion takes place is denser in the one case than in the other. In the same way, the diverse atoms, vibrating in the denser atmosphere formed on combination, show their vast superiority as radiators over like atoms, which, except in such special cases as ozone, &c., are incompetent to produce a similar condensation. The speaker then asked them to echo the resolution so well put to the meeting by Professor Williamson.

ELECTRO-CAPILLARY ACTIONS.

In a recent note on this subject to the Paris Académie des Sciences, M. Becquerel writes as follows:—

Electro-capillary actions depend on a principle which is of frequent application in organic and inorganic nature; they appear wherever two liquids, which are conductors of electricity and have an affinity for each other, are separated by a partition of capillary structure which the liquids enter in virtue of capillarity. The liquids then react on each other, and cause an electric current along the thin liquid layer adhering to the sides of the capillary passages, which acts like a solid conductor.

In order to constant intensity this must be constantly depolarised; and this condition is fulfilled when the elements deposited by electro-chemical action are removed by the meeting liquids.

This is an electro-capillary couple, and by means of it most metals may be reduced and other substances deoxidised. The metallic solution is placed in a cracked tube closed at the end, and this is plunged in a solution of monosulphuret of sodium. Two thick glass plates bound together may be used to hold the metallic solution.

The following experiment proves the conductive power of the sides of the crack when covered with liquid. If a concentrated solution of protoxide of lead in caustic potash be substituted for the solution of monosulphuret of sodium, this does not effect the reduction of the copper, the electromotive force being less than in the other case. But if an electric current from a nitric acid couple is caused to pass into the two solutions by two plates—one of copper, connected with the positive pole, and placed in the solution of nitrate of copper; the other of platinum, connected with the negative, and placed in the solution of plumbic potash—there is, shortly after, metallic copper deposited on that part of the crack in contact with the metallic solution, and on the opposite part peroxide of lead. The metallic solution is thus decomposed; the nitric acid has combined with the alkali, and the oxygen has peroxidised the lead. The current then becomes constant. The effect is the same as if a platinum wire were introduced to connect the two solutions, and the electric current passed by it only from the one to the other, the end of it in the metallic solution being the negative pole, the other the positive; and we may infer that the sides of the crack act in the same way as metallic electrodes. Before the deposit, oxygen and hydrogen are disengaged, one within, the other without the tube, and this must proceed from the decomposition of water. The disengagement increases with the deposition of the copper, as this deposit acts the part of conductor. Instead of a cracked tube, a tube closed at the lower end with parchment may be used, giving the same results.

The surface of a body covered with a thin layer of a liquid conductor of electricity adhering to it through capillarity, conducts like solid substances, though in a less degree. In a cracked tube, the internal and external surfaces, being only prolongations of the sides of the crack, ought to show the same physical properties as these; only that the sides of the crack being nearer the centres of chemical action, contribute more to the electro-chemical effect. The following experiment leaves no doubt as to this:—

The tube and vessel of the electro-capillary apparatus having been filled with water acidulated to 1-10th with sulphuric acid, and the air expelled by boiling, a platinum plate was put in each, and these plates were connected with the poles of several couples. The water was decomposed; and if the positive plate was in the liquid of the tube, small bubbles of oxygen formed on it and on the internal surface of the tube. We must therefore conclude that the glass surface acted as a positive electrode.

The electro-capillary couples already referred to are of a simple kind. We may increase the effect in the following way:—

We have seen that, when two solutions, one acid, the other alkaline, act on each other in a capillary space, that part of the capillary space in contact with the metallic solution is the negative pole, and the other the positive pole of the couple. The decomposing force of the current may be increased by aid of another current resulting from a similar chemical action. Communication is established between the two liquids by means of a curved tube (not capillary) containing a thick wick of asbestos, moistened previously with distilled water. The liquids rise on either side of the tube, meet, and react on each other; electricity is disengaged; the metallic solution sets free the positive electricity, the alkaline solution the negative, and the circuit is closed by the crack. Thus a current arises in the same direction as the electro-capillary current of the crack, and the force is increased. If the crack did not exist, or if the opening were not capillary, the two currents resulting from chemical action would destroy each other, going in opposite directions. The increase in force is in proportion to the diameter of the communicating tube.

This subject connects itself with the passage of blood in the arteries and veins, and the transformation of arterial into venous blood. In a previous memoir it was shown that the electro-capillary effects were produced in cracks of 0·030, 0·029, and 0·05 m.m. breadth, and the phenomena of hæmatosis take place in capillary tubes of similar diameter. As to the effects produced on contact of arterial and venous blood, we may suppose that the cause is, as in the phenomena we have been considering, electro-capillary. The sanguineous electro-capillary couple is constant, like the inorganic one: an indispensable condition of hæmatosis. This constancy arises from the fact that the electro-capillary current constantly removes from the arterial blood the oxygen contained in it, carrying it to the internal sides of the venous capillary tubes (which are positive), where it burns the carbonaceous matters and others which penetrate by infiltration.

It is not possible to verify the electro-capillary theory in a living being: and the conditions change after death; but the analogy of effects induces us to admit that of the causes.

EXAMINATION OF THE GASES OCCLUDED IN METEORIC IRON FROM AUGUSTA CO., VIRGINIA.

By J. W. MALLET, Ph.D., M.D.,
Professor of Analytical and Applied Chemistry, University of Virginia.[*]

The investigation by Graham of the gases given off by meteoric iron from Lenarto, in Hungary, when heated in a vacuum produced by a Sprengel-pump, excited much interest at the time of publication,[†] but does not seem to have been followed up by any similar examination of other meteorites. I have made use of pieces of the iron found about three years ago in Augusta Co., Virginia, the description and analysis of which were published by me in the *American Journal of Science* for July, 1871, in order to repeat the experiment of Graham and ascertain whether similar results to his would be obtained. A large part of the work of the extraction and analysis of the gaseous contents of this iron has been done by two of the students in my laboratory,—Mr. F. P. Dunnington, of Baltimore, and Mr. J. B. Adger, of South Carolina,—to whom I am much indebted for their assistance.

Two preliminary experiments were made; the first with some shavings from the cutting of the iron upon a planing-machine; the second with a solid piece of the metal planed to smooth, clean surfaces, and quite free from any crust or scale. The shavings were subjected to the purification practised by Graham, namely, washing with a hot solution of potassic hydrate, followed by washing with distilled water and thorough drying. The solid strip of iron was not so treated, care having been taken to use no oil upon the tool employed in cutting it. Both specimens gave off gas readily when heated in the Sprengel vacuum, the amount in each case being larger in proportion to the bulk of the iron than in the experiment of Graham; and analysis showed that the same gases were present as those found by him, with the addition of carbonic anhydride in not inconsiderable amount.

The final experiment was made as follows, with great care, and with all precautions which could be thought of to avoid error.

A parallelopiped of iron was cut upon a planing-machine, from the largest of the three masses found (that spoken of as No. 1[*] in the paper above referred to), the work being done with special care, to avoid the least trace of grease being derived from the machine.

Not only was the cutting-tool itself made red-hot in the blacksmith's fire, hardened in clean water, and tempered and ground without contact with anything greasy, but every part of the machine-bed, set-screws, and frame, from which any risk was to be feared, was carefully cleansed, and paper used to cover the whole of the iron, except where actually borne upon by the tool. The piece of iron measured about 75 m.m. long, 16 m.m. wide, and 12 m.m. thick. It was cut from as solid a portion of the mass as could be found, and was quite bright upon the surface and free from crust, though traces of a very minute crack or fissure were barely perceptible at one end. The piece weighed 124·589 grms.; and as the specific gravity of the iron had been found to be 7·853, the volume was 15·87 c.c. A new and perfectly clean porcelain tube, with sound glaze, was used, heated by a small upright fire-clay furnace with good draught, through holes in the opposite sides of which the tube was passed. The fuel was charcoal, in pieces a little larger than a walnut. The Sprengel's pump had a fall-tube of about 1·34 metres long; its connections were made with great care, and were protected by outer casings of india-rubber tube, with the annular space between the tubes filled with glycerine. A plate of glass, floating on the mercury in the funnel at top, served to prevent the risk of air being carried down, as the metal was gently poured on through another and smaller funnel with narrow aperture.

A good vacuum having been obtained in the cold, lighted charcoal was placed in the furnace, and gas very soon began to come off.

It was determined to analyse separately that collected at the beginning, middle, and end of the process, in order to see whether the different constituent gases were given

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[*] A paper read before the Royal Society.

[†] Read before the Royal Society, May 16, 1867.

[*] The results of ordinary analysis were.—

Iron	88·706
Nickel	10·163
Cobalt	0·396
Copper	0·003
Tin	0·002
Manganese	trace
Phosphorus	0·341
Sulphur	0·019
Chlorine	0·003
Carbon	0·172
Silica	0·067
	99·872

off at the same or at different rates. The total amount obtained was 36·33 c.c., reduced to 0° C., and 1 metre pressure. This was divided into three portions, for analysis, as follows:—

			h. m.
A.	52·02	per cent of the whole was collected in	2 30
B.	24·11	,, ,, ,,	2 20
C.	23·87	,, ,, ,,	9 40
	100·00		14 30

It will be seen that the greater part came off within the first two hours and a half; but the process lasted *fourteen hours and a half*, and was not entirely over at the end even of this time. The heat had been gradually raised from dull redness to something nearly approaching whiteness at the end of the time; and when the experiment was stopped, very small but still perceptible traces of gas were still coming off, though their appearance was immediately arrested whenever the temperature was allowed to fall but a little below the high point which had been reached.

The piece of iron taken out from the tube when it had become quite cold was found glazed by a thin film of fused phosphide of iron and nickel (Schreibersite), thickest on the edge which had been lowest, this phosphide having oozed out from the mass at the very high temperature used.

The tubes used to collect the gas during the first portion of the time occupied in the experiment were found slightly moistened on the inside, and the moisture, which had a distinctly acid reaction, was proved to contain hydrochloric acid, this having no doubt been derived from the chlorine existing in the iron in combination with that metal and with nickel.

Careful analysis of the gas yielded the following results by volume for the three portions separately collected: the fourth column of figures, obtained by summing up the three which precede it, gives the percentage composition of the whole of the gaseous matter extracted from the iron:—

	Portion A.	Portion B.	Portion C.	Total gas.
Hydrogen	22·12	10·52	3·19	35·83
Carbonic oxide ..	15·99	11·12	11·22	38·33
Carbonic anhydride	7·85	1·02	0·88	9·75
Nitrogen	6·06	1·45	8·58	16·09
	52·02	24·11	23·87	100·00

Other gases were tested for, but none could be found; no free oxygen could be detected, nor any compound of carbon and hydrogen.

From these figures it appears that hydrogen maintains about the same proportion to the other gases in A and B, but diminishes largely in C; that carbonic oxide increases in amount in B as compared with A, but remains about the same in relative amount in C; that carbonic anhydride diminishes throughout the whole continuance of the experiment; and that nitrogen falls off in B as compared with A, but largely increases again in C.

Contrasting the results with those of Graham, and noticing first the total volume of gas obtained from the iron, it becomes necessary to reduce this volume to the same standards of pressure and temperature employed by him. In the paper read before the Royal Society, as reported in its "Proceedings," I find no statement in regard to such standards; but, supposing it probable that the barometer at 30 inches and thermometer at 60° F. were referred to, I have calculated the volume of gas obtained in all from 15·87 c.c. of iron as equivalent under these conditions of pressure and temperature to 50·40 c.c., or 3·17 times the volume of the metal. This is a somewhat larger quantity than that of Graham, namely, 2·85 times the volume of the Lenarto iron used; but the time of heating was longer in the experiment now described, and the temperature attained probably much higher.

As to the nature and relative amount of the constituent gases, the results differ very noticeably from those of Graham, as is evident when the figures of the two analyses are placed side by side.

	Lenarto Iron.	Augusta Co., Virginia Iron.
Hydrogen	85·68	35·83
Carbonic oxide	4·46	38·33
Carbonic anhydride ..	—	9·75
Nitrogen	9·86	16·09
	100·00	100·00

The gases obtained in the experiment now in question agree more nearly with those of common wrought-iron (clean horse-shoe nails) as found by Graham,* viz., in the first portion collected—

Hydrogen	35·0
Carbonic oxide	50·3
Carbonic anhydride	7·7
Nitrogen	7·0
	100·0

and the conclusion arrived at by him, that "the predominance of carbonic oxide in its occluded gases appears to attest the telluric origin of iron," would deny to the Virginia specimen the right to be classed amongst meteoric masses, with which, however, all its other physical and chemical characteristics agree most fully.

It is to be noted that the analysis of the gases from the Lenarto iron was not made with the whole of the gaseous matter collected: the first portion, amounting to about 32·5 per cent of all collected, was used for merely qualitative examination; the second portion, 57·6 per cent, was that fully analysed; while no mention is made of the disposition of the remaining third portion of 9·9 per cent; and it is stated that the iron was not fully exhausted at the end of 2 hours and 35 minutes, for which time only the experiment was continued. In my own experiment it appears probable that the amount of hydrogen (and with it the total volume of gas) has been slightly diminished by its union with chlorine of metallic chlorides, to form the minute quantity of hydrochloric acid observed in the faint film of moisture on the sides of the first tubes; and probably also this moisture itself may have been caused by the partial reduction, by means of hydrogen, of carbonic anhydride to carbonic oxide. Although it might be assumed, especially in view of the strong tendency of iron to take up and "occlude" carbonic oxide, that this gas had been the original form in which the gaseous carbon compounds obtained existed in the iron, and that it had in part broken up at the temperature of the experiment into carbon, remaining united with the iron, and carbonic anhydride which escaped as gas,—yet, in view of the steady decrease in the quantity of this latter gas collected as the experiment proceeded and the temperature became higher, and bearing in mind the ready decomposition it undergoes in contact with ignited iron, it seems more likely that a larger amount of carbon originally existed in the iron in this higher state of oxidation than appears from the figures of the analysis. Although the proportion of hydrogen found is so much less in the Virginia than in the Lenarto iron, it yet represents for the former about 1·14 times the volume of the iron itself, whereas common terrestrial iron occludes but about 0·42 to 0·46 of its own volume under ordinary pressure.

I am quite satisfied, from the condition of the masses of iron as they came into my hands, and especially from the character of the crust, that the metal has not been subjected to any heating in a blacksmith's fire or otherwise by human hands since it was found, as has sometimes happened to similar specimens in the endeavour to discover their nature, or to make use of them.

Whether or not this analysis be considered as furnishing

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* *Loc. cit.*

presumptive evidence of the Virginia iron having come to our earth from a different atmosphere to that of which the Lenarto meteorite brought us a sample,* the result differs so far from that of our sole previously-recorded determination of the kind as to make it a matter of much interest that a larger number of meteoric irons, from various localities, should be subjected to careful examination in the same direction, thus supplementing our knowledge of the fixed constituents of these curious bodies by a study of their gaseous contents.

ON THE
ACTION OF DILUTE SALINE SOLUTIONS UPON LEAD.†

By M. M. PATTISON MUIR, F.C.S.

It has been long known that water, which has been kept for some time in leaden cisterns, dissolves and holds in solution a certain amount of the lead forming the cistern. Pure rain or distilled water, it has been remarked, does this to a very notable extent, and in some waters—especially those containing nitrates—the amount of Pb thus dissolved is very considerable. Waters containing nitrates, and even pure waters, have thus exerted a poisonous influence on persons drinking them, such effects being in many cases clearly traceable to the lead held in solution by these waters. On the other hand, notice has been taken of the fact that the presence—even to a very minute extent—of certain salts in the water, especially sulphates and carbonates, tends to diminish the solvent action of that water upon lead; and hence, before using very pure waters, it has been customary in some places to add certain quantities of soluble carbonates and sulphates, in order that these may act as a check to the solvent action of the water upon the leaden pipes through which it may have to pass. It seemed that a somewhat more definite statement than is generally found in the text-books, as to the amounts of Pb dissolved in a given time by waters containing various salts in solution, might not be devoid of interest or of practical use. As the water supplying so many towns traverses—for longer or shorter distances—leaden pipes, and as even very small quantities of lead held in solution by a water largely used for domestic purposes must through time exert a hurtful effect upon those using it, to determine actually how much lead is dissolved by a water of definite composition, and how much of some foreign substance must be added to stop this solvent action, appears a not unimportant problem; nor would I pass over the value which any reduction of a chemical action to definite figures must necessarily and intrinsically possess.

At the suggestion of Prof. Thorpe I have undertaken some measurements of this action of water on lead, the results of which I shall now state.

500 c.c. of distilled water were poured into a clean flask, and, after a number of such flasks were thus filled, there was then added to each weighed quantities of various salts. Pieces of clean bright lead were then suspended by threads in these solutions, so that the liquid should have free access to all parts of the Pb; thus the surface of Pb acted on could be accurately determined. In these experiments, the surface acted on was = 5600 sq. m.m. The flasks were then set aside for 24, 48, and 72 hours, at the expiration of each of which periods the amount of Pb dissolved was estimated. To do this I employed a slight modification of the method given by Wanklyn and Chapman, in their book on "Water Analysis." This process is essentially a colorimetrical one, the amount of Pb present being estimated by the depth of colour given to the solution, on the addition of H_2S, as compared with the colour given to an equal bulk of pure distilled water, to which is added a known quantity of a standard Pb solution.

The standard Pb solution employed contained 0·1 grm. Pb per lit. of H_2O, so that each c.c. corresponded to $0·0001 = \frac{1}{10}$ m.grm. of Pb. 100 c.c. of the solution to be tested were employed, and the reaction was of sufficient delicacy to detect easily 2 parts of Pb in 1,000,000 parts of water.

As to the composition of the solutions whose action has been tested, I have, in the first place, examined the action of Pb on solutions containing a determinate amount of only one salt in solution; then I have sought to answer the question—How would the addition of another salt act? would it retard or hasten the solvent action of the water on the Pb? If it retard this action, which salts, and how much of these, exercise such an influence to the most notable extent? If it hasten the solvent action, which salts do so in the greatest degree? Further, I have tried the action of a mixture of more than two salts in solution, thus approaching more nearly the conditions of an actual water. The results are embodied in the following table, in which the amounts of salts in solution in the water and the amounts of Pb dissolved are stated both in grms. per lit. and grs. per gall. :—

Salt.	Grms. per lit.	Grs. per gal.	Pb Dissolved. m.grm. per lit.			Pb. Dissolved grs. per gal.		
			24	48	72	24	48	72
NH_4NO_3	0·020	1·4	13·0	—	25·0	0·91	—	1·750
"	0·040	2·8	15·0	15·0	32·0	1·05	1·05	2·240
"	0·080	5·6	15·0	—	—	1·05	—	—
KNO_3 Na_2SO_4	0·020 0·050	1·4 3·5	2·0	2·0	—	0·14	0·14	—
KNO_3 Na_2SO_4	0·040 0·212	2·8 14·7	0·8	1·0	1·2	0·05	0·07	0·080
KNO_3 K_2CO_3	0·045 0·308	3·1 21·5	—	—	0·3	—	—	0·021
KNO_3 K_2SO_4	0·070 0·504	5·4 35·2	—	—	0·5	—	—	0·035
$CaSO_4$	0·252	17·5	0·4	—	0·8	0·02	—	0·050
"	0·408	28·5	0·4	—	1·0	0·02	—	0·070
K_2CO_3	0·310	21·7	—	—	0·2	—	—	0·014
"	0·516	36·1	—	—	0·2	—	—	0·014
$CaCl_2$	0·250	17·5	0·5	0·5	0·5	0·04	0·04	0·040
"	0·510	35·7	0·3	—	0·4	0·02	—	0·028
Na_2SO_4	0·200	14·0	—	—	0·8	—	—	0·050
"	0·400	28·0	—	—	0·5	—	—	0·030
NH_4NO_3 $CaCl_2$	0·020 0·060	1·4 4·2	—	—	1·8	—	—	0·126
NH_4NO_3 K_2CO_3 Na_2SO_4	0·020 0·100 0·200	1·4 7·0 14·0	—	—	0·4	—	—	0·028
Na_2SO_4 K_2CO_3 $CaCl_2$	0·200 0·040 0·100	14·0 2·8 7·0	—	—	0·1	—	—	0·007
Loch Katrine..	..	..	1·0	1·0	1·5	0·07	0·07	0·105
Distilled	..	..	2·0	2·0	3·0	0·15	0·15	0·210

The amounts of Pb dissolved in the same period of time, by waters containing different salts in solution, are thus seen to be very varied. Of all the salts whose influence upon the solvent action of pure water on lead was tested, nitrates—especially ammonium nitrate—increase that solvent action most largely. Perhaps the actual amount of nitrates generally present in water is not quite so great as that which I have experimented with, yet I would call attention to the fact that water containing the smallest quantity, viz., 0·02 grm. per lit., dissolved almost as much Pb as that containing double as much NH_4NO_3. Again, it should be noted that generally as much, or almost as much, Pb was dissolved after 24 hours' action as after 72 hours; so that, in keeping a water in leaden cisterns for domestic purposes, although this water may never remain long in contact with the Pb, yet doubtless it would—if a water containing nitrates—dissolve in a short time hurtful amounts of that metal. The action of chlorides, at least of the only chloride with which I have

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* Some of the observations of Secchi and Huggins seem to render it probable that carbon may play an important part in some regions of the universe, though the results on this head are not as full or satisfactory as those in reference to hydrogen.

† Read before the Glasgow Philosophical Society.

experimented ($CaCl_2$), seems to be a retarding, not a hastening action, as regards the amount of Pb dissolved: this has been noticed, both in the case of a water containing—as compared with distilled water—only chlorides, and also a water containing both chlorides and nitrates. Of those salts which have been experimented with, it is seen that the carbonates exercise a retarding action to the greatest extent; thus a water containing 0·31 grm. of K_2CO_3 per lit., = 21 grs. per gall., dissolves, after 72 hours' action on clean, bright lead, only about $\frac{1}{10}$th of a gr. per gall. of water; or, in other words, the presence of 1 part K_2CO_3 in 3000 parts H_2O almost completely prevents such a water from exercising any solvent action on Pb. The soluble sulphates also exercise a very important retarding action, nearly as great—although not quite so—as that of the carbonates. If a water containing nitrates, even amounting to 0·02 grm. per lit., an unusually large amount, contain at the same time sulphates, as small a quantity as 0·05 grm. per lit., the solvent action of such a water on Pb. is thereby very much diminished,—diminished in the proportion of 13 to 2. The same deterrent action is exhibited by carbonates, with 0·045 grm. KNO_3 and 0·308 grm. K_2CO_3; the amount of Pb dissolved, proportionately to that made soluble by a water containing the same amount of KNO_3, but without any carbonates, was as 16 is to 0·3. The carbonates are thus even more beneficial than the sulphates, in the case of waters containing nitrates, and, as I before remarked, also in waters free from nitrates. When nitrates, carbonates, and sulphates are present together in a water, then the solvent action of this water on lead is almost *nil*. This is also the case if the sulphates or carbonates be replaced by chlorides, although in the latter there is a slightly greater action than in the former instance: thus, if to a water containing 0·02 grm. NH_4NO_3 per lit. be added double as much (0·06 grm.) $CaCl_2$ per lit., then the amount of Pb dissolved by this water is exceedingly small—about $1\frac{3}{4}$ m.m. per lit. in 72 hours. This action is one of some importance, as, generally speaking, water containing nitrates contains also chlorides, both perhaps coming from the same or similar sources.

From all these experiments I conclude that although we may, on analysis, detect a pretty large amount of nitrates, yet we must not hastily condemn such a water,—as far as its action on lead is concerned, I mean,—but must carefully determine whether there be not also such amounts of other salts—as chlorides, sulphates, or carbonates—present as shall, to a great measure, neutralise the hurtful action of the nitrates. Unfortunately we do not, as yet, possess reliable information as to the amount of lead which is positively hurtful to the vital economy; but we may perhaps say that a water containing 1 gr. per gall, would not generally be looked on with favour. That Loch Katrine water actually does exercise a solvent action on Pb cannot be doubted.

In my experiments, the amount dissolved by ordinary water, taken from the Laboratory tap, was 1 m.m. per lit. = $\frac{7}{10}$ gr. per gall, after 24 hours action of the water on a clean, bright piece of Pb. In 48 hours the amount of Pb in solution had not increased, and after a lapse of 72 hours the increase only amounted to about $\frac{3}{10}$ gr. per gall. As our cisterns are generally very far from being bright and clean, and as, after the first few hours, the solvent action diminishes very notably, we may conclude, I think, that the actual amount of Pb taken into the system along with the water we drink is not considerable. Does this amount of Pb thus gradually deposited in the system slowly find its way out again, or does it remain accumulating all through life? Does this in any way influence the general health of our bodies? May the healthiness of some places be influenced materially by the amount of Pb dissolved by the water in constant use? These are questions yet remaining to be answered—questions which are to be solved more by the physiologist than by the chemist.

ON OPTICAL PHENOMENA PRODUCED BY CRYSTALS SUBMITTED TO CIRCULARLY POLARISED LIGHT.*

By WILLIAM SPOTTISWOODE, LLD., M.A.,
Treasurer R.S. and R.I.

ON a former occasion I exhibited some phenomena depending upon circular, or, as it was then also called, successive, polarisation, and in particular I adopted and explained a method for producing circularly polarised light devised by Sir Charles Wheatstone. I propose, on the present occasion, to pursue the subject into some of its ulterior consequences. In terms of the wave theory, light is said to be circularly polarised when the vibrations are circular, as distinguished from plane polarisation, when they are rectilinear. And further, it is known from mechanical principles that a circular vibration may always be produced by the combination of two rectilinear vibrations, the amplitudes or extents of which are equal, and whereof one is advance or in rear of the other by one or by any odd number of quarter-wave lengths. In the former of these cases the circular motion will take place in one direction, say right-handed; in the latter in the opposite, say left-handed. The contrivance I will now use for producing circular polarisation is known by the name of a "quarter-undulation plate," and consists of a plate of mica split to such a thickness that one of the two rays into which plane polarised light is divided on entering it is retarded by an odd number of quarter-wave lengths behind the other.

The optical phenomena produced by crystals, when submitted to polarised light, are usually divided into two classes, viz. (1), those arising from the use of parallel light, and consisting of broad sheets of colour; and (2), those due to convergent light, and consisting of the rings and brushes, the general character of which is well known. I propose to take a few specimens from each class, and to examine the modifications which the known phenomena undergo when the light is both polarised and analysed circularly, *i. e.*, when one quarter-undulation plate is interposed between the polariser (Nicol's prism) and the crystal to be examined, and the second between the crystal and the analyser (Nicol's prism).

In the first place, it is known that if a plate of selenite be placed in an ordinary apparatus when the polariser and analyser are either parallel or crossed, there are four positions, at 90° apart, in which the plate will produce colour; and further, that if the analyser be turned through 90° the same result will be obtained, except that the colour will be complementary to that first seen. The intensity of the light at any given point is then given by the formula—

$$\cos.^2 s - \sin. 2i \sin. 2 (i - s \sin.^2 \frac{\theta}{2},$$

where i and s are the angles made with the original plane of polarisation by the principal sections of the crystal and of the analyser respectively, and θ is the retardation.

If, however, the two quarter-undulation plates (say the plates A and B) be introduced, the light undergoes the following processes:—First, it is plane polarised by the polariser; secondly, the plate A being placed so that its axis is inclined at $\pm 45°$ to the original plane of polarisation, the light undergoes right- or left-handed circular polarisation, and in that condition falls upon the crystal; thirdly, in their passage through the crystal C the rays are each divided into two, whose vibrations are at right angles to one another, and whereof one is retarded in proportion to the thickness of C; fourthly, the plate B being placed so that its axis is parallel or perpendicular

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* Read before the Royal Institution of Great Britain.

to that of A, each of these sets of rays is circularly polarised, one set right-handed and the other left-handed; fifthly, these two oppositely circularly polarised sets of rays combine, according to known mechanical laws, on emerging from B, into plane rays, in which the planes of polarisation, of the different colours of the spectrum are turned through different angles. Hence, finally, by turning the analyser round we shall cross these various planes in turn, and successively extinguish the different colours, leaving the complementary colours visible. The system of plates A C B consequently acts in this respect like quartz. It is, however, to be observed, that if the plate B be turned from one of the two proposed positions to the other, the directions of motion in the two emergent circularly polarised rays, and consequently the planes of polarisation of the different colours, will be reversed; in other words, with the plate B in one position we shall imitate a right-handed, with the plate B in the other a left-handed, quartz. The intensity of the light at any point is then given by the formula—

$$\sin^2 \frac{\theta}{2} \text{ for one position,}$$

$$\cos.^2 \frac{\theta}{2} \text{ for the other.}$$

Again, if—the plates A B retaining either of the positions before indicated—the crystal C be turned round in its own plane, then, since the light emerging from A and B is circularly polarised, it has lost all trace of direction with reference to the positions of the polariser and analyser, and consequently no change of tint will be observed. The same is abundantly clear from the formula written above, because the only term it contains depends upon the retardation within the crystal C. This experiment was made by Airy.

If the plates A and B have their axes directed 45° on either side of the axis of C, and the three plates be turned round as one piece, the colour will remain unchanged; while, if the analyser be turned, we have the colours shown in the regular order. If the plates A and B have their axes directed at 45° on the same side of the axis of C, and the pieces be turned round bodily as before, the colours change in the same order as above, and go through their cycle once in every 90° of rotation; and if the analyser be turned in the same direction, the colours change, but in the reverse order. The explanation of this is to be found in the fact that, when the plates A and B are crossed, the retardation due by A is compensated by that due to B; so that the only effective retardation is that due to the crystal C. But upon this depends the rotation of the plane of polarisation: if, therefore, the polariser and analyser remain fixed, the colour will remain unaltered. When the plates A and B have their axes parallel there is no compensation, and the colour will consequently change. This experiment was made by Fresnel.

The mathematical expressions for the intensity of the light in the two cases respectively are—

$$\cos.^2\left(j+i+\frac{\theta}{2}\right), \text{ and } \cos^2\left(j-i-\frac{\theta}{2}\right),$$

where i is the angle made by the principal sections of A with that of the polariser, and j that of the principal section of B with that of the analyser. The first expression is obviously unchanged when the angle between the polariser and analyser, viz.—

$$\frac{\pi}{2}+i+j,$$

is unchanged. It should be added that the rotation of the plane of polarisation, and consequently also the sequence of tints, does not follow exactly the same law in the above cases as in quartz.

We now come to the case of convergent light, that is, to the phenomena of crystal rings. And let us examine the effects produced by the same argument as before, viz., two quarter-undulation plates, A, B, one in front and one behind the crystal C. To quote from Mr. Airy:—"The first thing that srrikes us in this combination is that there is nothing, except in the crystal, that has any respect to sides. For the only incident light is circularly polarised; the only light allowed to emerge is circularly polarised. The appearance therefore of the coloured rings, &c., must be such as conveys no trace of any plane of polarisation, and must not vary as the crystal is turned round. In the common exhibition of the coloured rings the principal trace of the planes of polarisation is in the uncoloured brushes. In uniaxal crystals they form an eight-rayed star, composed of two square crosses, inclined at an angle equal to that between the planes of polarisation, every ray of which separates complementary rings. In biaxal crystals they compose two pairs of rectangular hyperbolas, the angle between whose asymptotes is the same as that between the planes of polarisation, and whose branches divide complementary rings. The two crosses, or two sets of hyperbolas, unite when the planes of polarisation are parallel or perpendicular. But in the case under consideration the rings exhibited by crystals will not be traversed by any brushes. Uniaxal crystals will exhibit circular rings without a cross; and biaxal crystals will exhibit complete lemniscates, without any interruption from curved brushes." And it is further to be noticed, as the formula given above indicates, that the centres of the rings will be bright or dark according as the analyser stands at 0° or 90°.

To pursue this matter further. Suppose that, the arrangements remaining otherwise as before, the analyser be turned round; then in any position intermediate to 0° and 90° the rings will be contracted and extended in opposite quadrants, until at 45° they are divided by two diagonals, on each side of which the colours are complementary. Beyond 45° the rings begin to coalesce, until at 90° the four quadrants coincide again. During this movement the centre has changed from bright to dark. If the motion of the analyser be reversed, the quadrants which before contracted now expand, and *vice versa*. Again, if the crystal (say positive) be replaced by another (say negative), the effect on the quadrants of the rings will be reversed. This method of examination therefore affords a test of the character, positive or negative, of a crystal.

A similar process applies to biaxal crystals; but in this case the diagonals interrupting the rings are replaced by a pair of rectangular hyperbolas, on either side of which the rings expand or contract, and the effect is reversed either by reversing the motion of the analyser, or by replacing a positive by a negative crystal, or *vice versa*. The experiment may then be made in biaxal crystals, by turning the analyser slightly to the right or to the left, and observing whether the rings advance towards, or recede from, one another in the centre of the field. In particular, if polariser and analyser being parallel, the plate A have its axis in a N.E. direction to a person looking through the analyser, the plate B its axis in a N.W. direction, and the crystal be so placed that the line joining the optic axes be N.S., then, on turning the analyser to the right, the rings will advance to one another if the crystal be negative, and recede if it be positive. The mathematical expression for the intensity of the light at any point P is in this case—

$$\tfrac{1}{2}(1 + \sin.\ 2j \cos.\ \theta + \sin.\ 2b \cos.\ 2j \sin.\ \theta),$$

where b is the angle between the principal section of C through P and the principal section of B, and j the angle between the principal sections of B and the analyser. This shows that when the polariser and analyser are parallel or crossed at 0° or 90°, and consequently $j=45°$ or $135°$, the expression is independent of b, *i.e.*, the intensity is the same throughout circles about the centre, but that when the polariser and analyser are crossed we have an expression of the form—

$$\tfrac{1}{2}(1 \pm \sin.\ 2b \sin.\ \theta),$$

the sign of the second term depending upon the direction in which the analyser has been turned, and also upon the sign of θ, that is, upon the character (positive or negative) of the crystal.

The dispersion of the planes of polarisation, effected by the passage of plane polarised light through a plate of quartz cut perpendicular to the axis, may be rendered visible by interposing such a plate of quartz between the polariser and a uniaxal or biaxal crystal, when the analyser is at 90°, *i. e.*, when dark brushes are formed. In this case the brushes cease to be black, and are tinged throughout with colour. The analyser must, however, be turned back or forward, according as the quartz be right-handed or left-handed, in order that it may cross in succession the planes of polarisation of the different coloured rays, and so produce the most vivid effects. The dispersion of the brushes by a plate of quartz may, however, be studied, by employing an additional polariser and quartz plate between the source of light and the whole system previously used. By turning this polariser round we extinguish each ray of the spectrum in turn, and tint the whole field with the complementary colour. The brushes will then appear to revolve about their centres as the tints vary continuously from one end of the spectrum to the other. If the polariser be turned still farther round, the tints which had changed continuously from red to violet, or *vice versa*, change suddenly from violet to red, or *vice versa*, and the brushes jump suddenly back to their original position.

This last optical arrangement may be employed to examine the more important phenomena of the dispersion of the optic axes produced, not by a quartz plate between the usual polariser and crystal, but by certain biaxal crystals themselves.

ON A RELATION BETWEEN THE SURFACE-TENSION OF LIQUIDS AND THE SUPERSATURATION OF SALINE SOLUTIONS.[*]

By CHARLES TOMLINSON, F.R.S., and G. VAN DER MENSBRUGGHE.

(Concluded from p. 282.)

We now pass on to consider the second proposition, namely, that if on the surface of a supersaturated saline solution there be deposited a drop of a liquid of feeble tension, the drop spreads and crystallisation is determined. Now it is shown in Part II. that drops of ether, of alcohol, and of similar volatile liquids, as well as of certain oils, both volatile and fixed, spread over the surface of the solutions and act as powerful nuclei. On the surface-tension theory, a liquid such as ether, of which the tension = 1·88, or alcohol = 2·5, or wood-naphtha = 2·11, or oil of lavender = 2·9, must spread on the surface of a supersaturated solution of Glauber's salt, of which the surface-tension is as high as from 4 to 5·2. This is true in a large number of cases that have been observed, and so far the phenomena are consistent with the theory. But there are cases in which liquids of low tension, such as oil of turpentine = 2·2 to 2·4, and some varieties of castor-oil = 2·5, do not form films, but well-shaped lenses, and remain as such during many hours and even days. Quincke seems to have met with cases of this sort in his elaborate inquiry on the capillary phenomena of the common surface of two liquids,[†] and he endeavours to account for these exceptions to the general law, by the statement that if a lens-shaped drop of a liquid 2 (of low tension) remain on the free surface of a liquid 1 (of much higher tension) without spreading itself out, then it is certain that in most, and probable that in all cases the free surface of liquid 1 is rendered impure by a thin layer of a foreign liquid 3. Now in experiments on supersaturated saline solutions, the flasks, the filtering apparatus, and the solutions must be, as already explained by one of us, chemically clean, so that in boiling and filtering a solution into clean flasks in which it is boiled up again, covered over and left to cool in the open air of the country, it is difficult to imagine the existence of such a film as M. Quincke refers to. Moreover, did such a film exist, the solution in cooling would probably become solid under its action. Indeed, this sometimes happens in the case of flasks that have been already used in experiments on the nuclear action of oils; for, however carefully they are cleansed, it may happen that one or two out of a dozen may not be quite clean, so that, in the cooling of a boiling solution, a film detached from the walls of the flask may spread over the surface with nuclear action. In order, if possible, to prevent the formation of such a film, the following experiment was made:—

Expt. 8.—A solution of 1 part of Glauber's salt to 1 of water, with the addition of a bit of caustic potash, was boiled and filtered into four clean flasks. When cold, a drop of castor-oil was deposited upon the surface of each of the solutions. It flattened at first, but soon recovered the lenticular form. There was no nuclear action during an hour. On gently shaking the flasks, the oil was diffused through the solution without nuclear action.

In an experiment described in Part II. fragments of stearine were scraped into a solution with immediate nuclear action. In such a case, the stearine furnished the film-forming material that produced the solidification of the solution. The solution was boiled with the stearine in it, and in cooling the stearine formed into solid disks without nuclear action, although the flask was frequently shaken. In this case the boiling solution had saponified or otherwise removed the film-forming matter, or, in other words, had made the stearine chemically clean.

There is also a difficulty in the case of oil of turpentine, as in the following experiment:—

Expt. 9.—A drop of an old but clear and bright oil of turpentine was deposited on the surface of a solution containing 2 parts of salt to 1 of water. The drop flashed out into a film, and the solution immediately became solid. The turpentine was now distilled, and a drop of the distillate was deposited on a similar solution, when it formed a well-shaped lens with no nuclear action, although the flasks were left out during several days.

Now the tension of the old oil first used is = 2·2, and had the effect of distillation been greatly to exalt the tension, the experiment would have been intelligible according to the theory; but on measuring it the tension was found to be only 2·4.

A somewhat similar case is given in Part II., in which an old oil of bitter almonds was strongly nuclear, while the same oil freshly distilled had no such action, but became converted into benzoic acid, still without any separation of salt. After some days, to prove that the solution was still supersaturated, it was touched with an unclean wire and it immediately became solid.

Still, however, there are such a large number of cases in which oils and other liquids spread upon the surface of the solutions with nuclear action as to justify the labour bestowed upon the theory by one of us during the last six months. Many of these cases are stated in Part II., but a few of them may be repeated here for the sake of comparing the action of such liquids upon solutions of different strengths which was not done before.

If we take a number of oils, the tension of which varies from about 2·5 to 3·5, a drop of any one of them, according to the theory, ought to spread on the surface of a solution where t = 5·2, and not in all cases spread on the solution of which t = 4.

Expt. 10.—Twelve flasks, containing a solution of

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[*] A paper read before the Royal Society.

[†] *Pogg. Ann.*, cxxxix. See also *Phil. Mag.* for April, 1871.

1 part salt to 1 of water were prepared, and a drop of each of the following oils formed films with immediate crystallisation of the solutions, viz. pale seal-oil, sperm-oil, cotton-seed oil, and niger-oil. A drop of linseed-oil formed a lens, but this soon becoming ragged, crystals diverged from it. A drop of castor-oil formed a lens with no nuclear action.

Expt. 11.—Three of the above solidified solutions were heated over a lamp, boiled, and covered over. The oil collected on the surface in innumerable small disks. Next morning one of the solutions was found crystallised, and the other two became solid on gently agitating the flasks.

In this case as the solutions cooled down or were gently agitated the disks spread out into films with nuclear action.

Expt. 12.—A solution of 3 parts salt to 1 of water was filtered into twelve flasks, when a drop of each of the following oils deposited on the surfaces of the solutions, became lenticular without any separation of salt, viz. pale seal-oil, olive-oil, rape, castor-oil, croton-oil, niger, sperm, and cotton-seed oil.

So far this result is in accordance with the theory.

Expt. 13.—A solution of the same strength as in the last experiment was employed, when a drop of seal-oil, sperm, cotton-seed, and niger spread out into films with powerful nuclear action. Linseed- and castor-oil formed lenses with no such action.

Now it must be remarked that on the day when Expt. 12 was made the weather was dull, damp, and cloudy, and during the time of Expt. 13 the weather was bright and clear. Some years ago it was a matter of frequent observation to one of us, that the formation of cohesion-figures on the surface of water was much more rapid and decisive, with altogether finer and sharper results, in bright weather as compared with dull, damp, wet, or foggy weather. The same remark applies to the motions of camphor on water, and to those curious phenomena known as "camphor currents" and "camphor pulsations."[*] Now in the production of all these phenomena, as has been shown by one of us,[†] surface-tension plays a most important part, and such tension is lowered in dull foggy weather probably by the condensation of the vapour of volatile matters contained in the atmosphere. A drop of a liquid under such conditions may not spread on the surface of water or of mercury, the latter being especially liable to such influences; whereas on a bright day such surfaces are particularly active, and experiments succeed which some hours or days before failed to produce the results expected.

Then, again, as pointed out by one of us in Part II., the viscosity of the surface, or of the drop of liquid placed upon it, may greatly interfere with the operation of the law by which a liquid B spreads upon the surface A. A supersaturated saline solution has a considerable viscosity of surface, which it retains for many hours after it has cooled down. In the course of about twenty-four hours the more watery particles come up to the surface and the tension improves, so that the same surface which may have sufficient tensile force to cause a drop of oil to spread upon it, might some hours earlier have retained it in the lenticular form.[‡]

There are also certain modifications to which oils, &c., are subject in consequence of the presence of ozone and other matters in the air, which may somewhat disturb the results expected to be obtained from the action of surface-tension.

It was stated in Part II. that when an oil, &c., assumes the lenticular form, the solution may be agitated so as to break up the lens into a multitude of globules, and give the solution the appearance of an emulsion. In such a case the tensions of the two liquids are of nearly the same value; if not the agitation often produces crystallisation; but even in the former case it was stated that a sudden jerk will sometimes produce immediate solidification of the solution. Now taking the tension of the solution at 5·2, and that of oil of olives at 3·7, and the tension at the surface of separation of the solution and the oil-lens at about 2, then the sum 3·7+2 is equal to the tension of the solution, and the spreading on the surface ought to be impossible, unless fine clear weather, absolutely clean vessels and solutions, and the absence of surface-viscosity, concur to increase the surface-tension of the solution. At the surface of separation of the solution and of the glass, spreading may be possible in the case of certain oils without these concurring circumstances. Suppose a drop or a minute globule of oil to be brought into direct contact with the wet solid side of the solution, as by the jerk above referred to, the film of solution is displaced and the oil can wet the solid side. It may happen that the tension t of the solution at the wall of the flask is greater than the sum of the tension t of the surface of separation of the solution and of the oil, plus the tension of the oil in contact with the solid side; that being the case, the instant solidification consequent on the jerk is accounted for.

It will be seen then that when the drop of oil, &c., remains as a lens on the surface, there is a diminution of tension at the surface of the solution in contact with the oil; but in such a case the tension is not sufficiently lowered at one point as to render molecular equilibrium impossible at this point, and so break up the whole system of supersaturation. But if the solution be agitated, so as to bring into contact with the surface of the glass a portion of the drop, there will still be diminution of tension at the surface of the solution in contact with the solid, and now the diminution is sufficient to produce crystallisation. Thus it appears that oils may act differently according as they alter the tension of the liquid freely exposed to the air, or the tension of the liquid in contact with the glass, which is not of the same value.

With respect to Proposition III. there is no difficulty. A liquid of considerable contractile force, such as pure water, produces no separation of salt in a solution of less contractile force. This explains a number of cases described in a note by one of us submitted to the Society in July last,[*] in which solutions exposed for hours together to heavy rain did not crystallise, unless the rain brought down a speck of soot or some unclean body that lowered the surface-tension of the solution. Indeed we know of no liquid of superior tensile force to that of the solution, and not acting chemically upon it, that has any influence in producing crystallisation.

Proposition IV. also agrees with the phenomena. A glass rod or other solid, more or less smeared with a film of a liquid of low tension, when brought into contact with the solution determines crystallisation by lowering the surface-tension. Such, then, is the function of a nucleus with respect to supersaturated saline solutions. If the solid be made chemically clean, it may be plunged into the solution without altering its tension, and hence there is no separation of salt. And here it may be remarked that such a case is possible that a crystal of the salt itself may be brought into contact with the solution without disturbing its tension, and hence be inactive. It has never been pretended that a crystal of the salt is not a good nucleus for a supersaturated solution of its own kind. All that has been stated by one of us is that, under special conditions, such a crystal may be lowered into the solution without acting as a nucleus.

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[*] *Phil. Mag.* for December, 1869.

[†] "Sur la Tension superficielle des Liquides," par G. Van der Mensbrugghe.

[‡] Some of the distinguished physicists who are now engaged in studying the phenomena of surface-tension refer to the embarrassing effects of surface-viscosity. Thus Herr Lüdtge remarks that a solution of soap (t=2·8 to 3) does not spread upon a solution of Panama-wood (t=5·7); and it has been shown by one of us that the viscosity of the surface explains why a solution of soap does not spread on a solution of saponine or of albumen; and, on the other hand, the liquid drop being viscous, there is no extension, or only a feeble one, since the slight difference in tension is equilibrated by the resistance of the viscous liquid.

[*] *Proc. Roy. Soc.*, vol. xx., p. 41.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, May 27, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Iron Contained in the Blood and in Food.—Dr. Boussingault.—This exhaustive physiologico-chemical memoir treats on the part which iron plays in the animal as well as vegetable kingdom, and on the quantity of that metal present in the human body; in animals; in various vegetable substances; in water, wine, beer, and sea-water. This paper is elucidated by a series of tabulated forms, containing the results of experiments. It appears that the mollusks and other invertebrate animals contain almost as much iron in their blood as the vertebrate animals, while cryptogamic plants also contain a large proportion of the metal.

On an Aldehyde-Alcohol.—A. Wurtz.—This essay contains a detailed account of the mode of formation, combinations, and products of decomposition, of a body derived from aldehyde, and which, at the same time, plays the part of an ordinary alcohol and of an aldehyde. The formula of this new compound—which is formed when a mixture of 1 part of aldehyde, 1 part of water, and 2 parts of hydrochloric acid, is left standing for some days—is $C_4H_8O_2$, and termed aldol by the author. At 0° this substance is a very viscous fluid, having a sp. gr. = 1·1208; at a higher temperature it is as fluid as water: at above 100° it becomes decomposed, yielding water and crotonic aldehyde, C_4H_6O. Aldol reduces ammoniacal nitrate of silver and the cupro-potassic liquor; heated with anhydrous (glacial) acetic acid it is decomposed, yielding again water and crotonic aldehyde; it combines, however, with glacial acetic acid, when they are heated together on a water-bath for some days.

On a New Organic Base Derived from Sugar.—G. Bouchardat.—By treating the bromhydric and chlorhydric ethers of dulcite [$C_{12}H_{14}O_{12}$] with strong ammonia, the author has obtained a new organic base, which he terms dulcitamine, $C_{12}H_{15}NO_{10}$. The chlorhydrate of this base is prepared by heating to 100°, for a period of 6 hours, 1 part of monochlorhydric dulcitan, $C_{12}H_{11}ClO_8$, with 10 parts of a saturated alcoholic ammonia. When this compound, the chlorhydrate of dulcitamine, is treated with water and oxide of silver, dulcitamine is set free. This base is a powerful alkali, which even displaces ammonia from its combinations, and forms with acids neutral salts; the chlorhydrate of dulcitamine forms with chloride of platinum a crystalline compound, $C_{12}H_{15}NO_{10}HClPtCl_2$, insoluble in water and absolute alcohol, but readily soluble in ether.

On Bleaching-Powder.—F. Crace-Calvert.—After first referring to Dr. Balard's ressarches on this subject (*Annales de Chimie et de Physique*, second series, vol. lvii., 1834), the author gives an account of his method of analysing bleaching-powder, and states that this material contains, on an average, 1 part of hypochlorite of lime to 2 parts of chloride of calcium. The author experimented with samples obtained from various chemical works.

Production of a Crystallised Phosphuret of Iron.—M. Sidot.—By passing the vapours of phosphorus over incandescent piano-wire (iron), the author obtains, after re-melting the first product, a highly magnetic crystalline phosphuret of iron, containing in 100 parts—Iron, 87·9; phosphorus, 12·1; formula, Fe_8Ph.

La Revue Scientifique de la France et de l'Etranger, June 1, 1872.

This number does not contain any original chemical papers, but we call attention to the following interesting memoir:—

History of the Observatory at Paris.—E. Yung.—This paper is divided into the following sections:—Origin; period of the Cassinis (1671—1793); period of the Convention (1793—1795): period of the Bureau des Longitudes (1795—1854); period of independent directors (1854—1872). In a sense this paper proves "que la France intelligente, éclairée et libérale ne périt pas," although the motto of the Parisian coat of arms, "Fluctuat nec Mergitur," applies to "la belle France" in many respects.

Continuation of the Lectures on Animal Heat.—Dr. C. Bernard.

June 8, 1872.

This number contains no original papers relating to chemistry, but we call attention to the continuation of the excellent lectures—

On Animal Heat.—Dr. C. Bernard.

American Journal of Pharmacy, June, 1872.

In addition to several important papers more particularly relating to pharmacy and pharmacognosy, this number contains the following original papers bearing upon chemistry:—

Citrate of Iron and Bismuth.—C. Rice.—The author describes the preparation of a liquid which contains citrate of bismuth and citrate of iron together in solution, the first-named salt being dissolved in dilute ammonia; ammonio-citrate of iron is added, and then—in order to make the solution keep—either glycerine or, better still, good sherry wine is added. This preparation is largely used in the United States in dyspepsia.

New Process for Detecting Bromide in Iodide of Potassium.—Dr. E. van Melckebeke.—If to a saturated solution of bromide of potassium a small quantity of pure iodide is added, it will completely dissolve, but if the iodide is contaminated with bromide of potassium this impurity will remain undissolved; 100 parts of water (distilled), at 16°, dissolves 140·10 parts of iodide of potassium, and the same quantity of water, at the same temperature, dissolves 63·39 of bromide of potassium; 100 parts of water saturated with bromide dissolve only 13·15 parts of iodide of potassium, and if more of that salt is added bromide is precipitated. As the solution of the salts in water causes a very sensible lowering of temperature, for testing the author recommends to dissolve pure bromide of potassium in warm water, to let this solution cool, and decant from the crystalline deposit. To 10 c.c. of this solution, 10 drops of water are added in a test-tube, and afterwards in small quantities, and, constantly shaking 1 grm. of the suspected iodide in coarse powder, if free from bromide it will dissolve almost instantly, while if bromide is present it will remain undissolved.

Annalen der Chemie und Pharmacie, No. 7, 1872.

This number contains the following original memoirs and papers:—

On Chrysanissic Acid.—Dr. H. Salkowski.—Too extensive for useful abstraction. It is divided into the following sections:—Introduction, containing a review of the labours and researches of others on this subject; preparation of chrysanissic acid; properties and combinations of this acid; products of decomposition of this acid; re-formation (*Rückbildung*) of chrysanissic acid; its formation during its preparation; dinitro-anisic acid; constitution of chryso-anisic acid and substances isomeric with it.

Influence of the Potassa and Soda Salts upon Alcoholic Fermentation.—C. Knapp.—After first referring, at some length, to the researches of physiologists on the action of the potassa salts upon the animal organism, the author details at length a series of experiments made with the view to ascertain the difference of action—if any—upon the process of fermentation of sugar solutions to which yeast is added. While it is evident, from these researches, that potassa salts accelerate the fermentation, while soda salts are inactive, the mode of action of the first-named salts is not precisely clear.

Researches on the Pigments Present in Bile.—R. Maly.—The third and concluding portion of this monograph treats of the conversion of bilirubin into urine-pigment.

Preliminary Communication.—E. Linnemann.—The main gist of this brief paper is, that the combination of acrylic acid with hydriodic acid is identical with the glycerin-iodpropionic acid.

Contribution to our Knowledge of the Cochineal Pigment.—C. Liebermann and W. A. van Dorp.—This exhaustive monograph is divided into the following sections:—Introduction, containing an excellent review of the labours of others on this subject; nitrococcic acid; trinitro-cresol; binitro-amido-cresol; ruficoccin; by-products of the preparation of ruficoccin.

Researches on Isomerism of the Benzol Series.—F. Beilstein and A. Kuhlberg.—The fourteenth instalment of this monograph. This part treats on cinnamic and benzoic acids; preparation of cinnamic acid; nitro-cinnamic acid; nitro-hydro-cinnamic acids; meta-nitro-benzoic acids; anthranilic and salicylic acids from metanitro-benzoic acids; nitro-α-toluyl acids; indol; nitrophenyl-chlorolactic acid; tyrosin.

Action of Active Oxygen upon Pyrogallic Acid.—H. Struve.—This essay contains the detailed account of a series of experiments made with the view of ascertaining the action of oxygen (superoxides) and ozonised oil of turpentine on pyrogallic acid. It appears that the last-named substance is completely converted into purpurogallin—a body described by Aimé Girard (*Zeitschrift für Chemie*, 1870, p. 86).

On Water-Baths with Constant Level.—J. L. Smith.—The detailed description of a contrivance for keeping water-baths—while in use in chemical laboratories—filled with a sufficient quantity of water.

Le Moniteur Scientifique Quesneville, May 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Essay on the Docimastic Extraction of the Bismuth Ores, and the Docimastic Method of Separating this Metal from Copper, Arsenic, Antimony, and Lead.—H. Tamm.—This exhaustive memoir is divided into the following sections:—Assay of bismuth ore; assay of bismuth ores containing much copper, and extraction of the metal from such ore; method of separating, on the large scale, arsenic from bismuth; method of separating bismuth from antimony; method of separating copper, sulphur, and lead, from bismuth,—all on the large metallurgical scale.

The Phosphates of Lime of Russia.—A. Yermaloff.—This paper, illustrated by a map exhibiting a portion of the Russian Empire, contains an account of the situation and extent of phosphate of lime deposits in that country. It appears that there are several very extensive deposits of native phosphate of lime, one of which occupies a surface of no less than 20,000,000 of hectares, each of which (=2·471 acres) will yield some 14,000 tons of this mineral, which on an average has been found to contain, by analysis, about 20 per cent of phosphoric acid.

Best Methods of Analysis of Artificial Manures.—L. Fresenius, C. Neubauer, and E. Luck.—This monograph is divided into the following chapters:—Methods of estimating phosphoric acid in general; special methods of estimating phosphoric acid; estimation of precipitated phosphates in superphosphate of lime.

Bibliography.—Under this heading we quote the title of the following work, which is very highly spoken of in the periodical abovenamed:—"Chimie Organique Elémentaire," par Edouard Grimaux: Paris, Germer-Baillière, 1872.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, April 11, 1872.

Physical and Chemical Properties of Various Kinds of Brass.—C. Mène.—A tabulated form, exhibiting the chemical formulæ, composition in 100 parts, sp. gr., atomic weight, colour of the fracture, breaking-strain in pounds, degree of ductility, degree of hardness, and degree of fusibility, of a number of alloys of copper and zinc.

Rapid Dryer (Siccatif) for Oil-Paints and Varnishes.—C. Mène.—In 100 parts of water are dissolved, by the aid of heat, 12 parts of best shellac and 4 parts of borax; this solution, after cooling, is poured into bottles, which should be well corked. According to the author, this solution may be mixed with some oil of turpentine, with oil-paints, to render them rapidly drying, while the liquid may also be employed as a varnish.

Glycerine as a Tanning Material.—C. Mène.—After first observing that glycerine is a substance which has been found by experience to be useful as a means of increasing the elasticity and strength of leather, the author states that leather (hides rather), first partly tanned by the usual process, may be greatly improved—especially if required for machine-belts—by being soaked for some time in glycerine.

Studies on Dynamometers.—C. Mène.—The continuation of an essay on this subject, copiously illustrated with woodcuts.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 233, May, 1872.

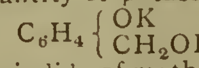
The only original paper relating to chemistry met with in this number is—

Report on an Ink which does not Corrode Steel Pens.—Dr. Balard.—This exhaustive memoir contains much valuable information on inks in general. The use of inks of a similar composition to that now generally employed appears to be of more ancient date than is generally supposed, because the author mentions, in the historical introduction to his report, that on examining a manuscript of the year 910, and belonging to the papers of the Cluny Abbey (Paris), it was evident that the ink it was written with was similar in composition to that now in use: it further appears that MM. Coupier and Collin have succeeded in preparing an ink which very nearly answers to the conditions required by the Society for its prize medal, which, however, has not yet been granted to MM. Coupier and Collin, though in order to encourage their labours a sum of £20 has been awarded them. This ink is well worthy of general notice, as it is not acted upon by nitric and hydrochloric acids, chlorine, or bromine; it is, however, not quite proof against alkalies.

Gazzetta Chimica Italiana, Nos. 2 and 3 (double number), 1872.

This number contains the following original papers and memoirs:—

On Anisic and Methylsalysilic Alcohols.—S. Cannizzaro and W. Koerner.—The authors give an account of their researches on the anisic-alcohol as compared with the therewith isomeric methylsalysilic alcohol (methylsaligenin). The first-named product has been prepared by the action of alcoholic potassa upon anisaldehyde, while the methylsaligenin is prepared by adding to a solution of saligenin in wood-naphtha the requisite quantity of potassa to form first—



$$C_6H_4\left\{\begin{array}{l}OK\\CH_2OH.\end{array}\right.$$

which is next boiled with iodide of methyl. Methylsaligenin is at the ordinary temperature an oily fluid which is difficultly solidified when exposed to the action of a mixture of solid carbonic acid and ether; anisic alcohol is crystalline, and fuses at 25°.

Anisic-alcohol.	Methylsaligenin.
Boiling-point 258·8° at 760 m.m.	Boiling-point 247·5° at 765 m.m.
Sp. gr. at 26° = 1·1093	Sp. gr. at 23° = 1·1200
„ „ at 100° = 1·0507	„ „ at 100° = 1·0532.

Measurement of the Index of Refraction of Anisic and of Methylsalysilic Alcohols.—P. Blaserna.—An algebraico-optical essay.

Detection of Iodine when Present in Urine in the State of an Iodide.—Dr. P. Pelloggio.—The main gist of this essay is that, according to the author's researches, electrolysis of iodine containing fluids, previously mixed with hydrochloric acid and starch-water, is the most sensitive method for detecting very small quantities of iodine.

Nature of the Colouring Matter met with on the Urn of St. Ambrosius, at Milan.—R. Frapolli, R. Lepetit, and P. Padulli.—On the urn of St. Ambrosius,—dating from the ninth century,—being recently opened at Milan, it was found to contain along with earthy matter some colouring substance, which, on being tested by the authors, was found to consist of indigo and shellac.

New Method for Detecting Fuchsin.—G. Romei.—The author refers at considerable length to the researches of various authors who have devised methods for detecting fuchsin in syrups, sweets, &c. It appears that wines are also sometimes artificially coloured with fuchsin; and the author proposes to treat the wines with amylic alcohol after previous treatment with acetate of lead for precipitating the peculiar wine-colouring pigment.

Chemico-Microscopic Research of a Peculiar Substance which Accompanied the Meteoric Dust which Fell in Sicily on 9th, 10th, and 11th March Last.—O. Silvestri.—The peculiar substance, designated popularly as blood-rain, was found to consist in 100 parts of red iron ochre, 75·1; carbonate of lime, 11·7; organic matter, 13·2.

Programme de la Société Hollandaise des Sciences de Haarlem, 1872.

From this paper we learn with pleasure that an Englishman has had awarded to him the first "Boerhaave" medal—the gentleman being Mr. H. Clifton Sorby, F.R.S., of Sheffield, who has obtained this distinction for his excellent microscopical researches in reference to mineralogy and geology. Mr. Sorby has been elected one of the foreign members of this ancient scientific institution, an honour likewise conferred upon Dr. C. A. Würtz of Paris, and the Right Hon. Lothrop Motley, temporarily residing at the Hague. We quote from this programme the following prize-questions relating to chemistry:—To be answered on or before 1st January, 1874: To study in detail the influence which physical and chemical modifications of the dissolving agent exert upon the form of carbonate of lime when it is deposited from aqueous solutions; what are the chemical changes which stone-bearing fruits undergo during their development? to be elucidated by original chemical researches and analysis; to find satisfactory means for determining the temperature, degree of hygroscopity, and the density of the atmospheric air at a considerable distance above the earth's surface; these means ought to be either such that automatic registration is possible, or so contrived that the observations can be frequently repeated. In addition to the gold medal (the ordinary prize) a sum of £25 will be awarded for satisfactory answers to this question.—To be answered on or before 1st January, 1873: Exactly-made determinations of the density (sp. gr.) of pure water *free from air* at different temperatures expressed in degrees of the air thermometer; quantitative chemical analysis to be made of different kinds of glass of which the co-efficient of refraction is known; new researches to be made on the liquids and gases occluded in small cavities of native crystals. The memoirs to be written (not, however, in the handwriting of the authors) in Dutch, Latin, English, French, Italian, or German languages (not with German characters), and to be accompanied by a sealed note, bearing inside the author's name, and outside a motto, also to be written on the fly-leaf of the memoir, to be sent, carriage or postage paid, to Dr. E. H. von Baumhauer, secretary of the Society at Haarlem, Holland. The sealed notes of the memoirs to which no prize is awarded are destroyed unopened unless the memoir is found to be a copy or abstracts from printed works. The ordinary gold medal of the Society, the prize awarded, has an intrinsic value of £12 10s., while in some cases that sum is added to the medal.

Les Mondes, June 6, 1872.

This number contains no original papers relating to chemistry or collateral matters.

NOTES AND QUERIES.

Iodine.—I wish to estimate the percentage of iodine in such products as kelp. Can any reader kindly recommend a method combining quickness and accuracy?—J. S.

Salts of Chromium.—I am anxious to learn whether it is possible to make salts of chromium perfectly free from iron either commercially or as laboratory specimens?—Chromium.

MEETINGS FOR THE WEEK.

Monday, June 24th.—Royal Geographical, 8½.
Wednesday, 26th.—Society of Arts, 4.
Thursday, 27th.—Royal Society Club, 6½ (Anniversary).
—— Philosophical Club, 6.
Friday, 28th.—Quekett Club, 8.

TO CORRESPONDENTS.

T. R. Y.—Cooley's "Cyclopædia of Practical Receipts" is published by Messrs. J. and A. Churchill, price 28s.

J. Parry, W. Thorp, jun., S. E. Phillips.—These correspondents are thanked for their communications, which shall receive attention.

THE CHEMICAL NEWS.

Vol. XXV. No. 657.

ON THE
OXIDATION BLUE OF BOLETUS CYANESCENS, B. LURIDUS, &c.,
AND ON A
SIMILAR PRODUCT DERIVED FROM PHENOL.

By T. L. PHIPSON, Ph.D, F.C.S., &c.

In a former paper[*] I attributed the intense blue colour produced by hypochlorite of lime in the alcoholic solution of the yellowish colouring matter of *Boletus luridus*, &c., to the presence of phenylamine (aniline) in the tissue of these fungi; though, in the absence of sufficient data relative to the composition of the colouring matter, this opinion was put forth as little better than a conjecture.

Recently a paper on the same subject has been published by Mr. H. Ludwig,[†] whose method of experimenting has not enabled him to detect aniline, though he has convinced himself of the presence of nitrogen in the colouring matter; and had he pushed his investigation a little further, I am convinced he would have obtained some phenyl derivative also.

I have more recently obtained, artificially, a blue colour exceedingly like that yielded by oxidation of the freshly-cut surface of these *Boleti*. A small quantity of ordinary phenol is dissolved in methylic alcohol saturated with ammonia. To this, hypochlorite of lime is added cautiously, in small quantities, until an intense blue colour is produced. This is soluble in water. The aqueous solution, considerably diluted and acidified by hydrochloric acid, is reddish or pinkish, but after a while deposits a small quantity of a dark resinous substance, and then it is a clear yellow solution, which in presence of ammonia takes a blue colour, in a very few minutes, *by contact with the air*.

This yellow solution, to which a few drops of ammonia have been added, behaves exactly like the freshly-cut surface of *B. luridus*, and the ephemeral blue colour produced is very similar to that of the fungus, though they may not be absolutely identical in composition. Nevertheless, this experiment induces me still to believe that the blue colour derived from *Boleti* belongs to the phenyl group.

ESTIMATION OF CARBON IN PIG-IRON, WROUGHT-IRON, AND STEEL,
BY
COMBUSTION WITH OXIDE OF COPPER IN VACUO UNDER SPRENGEL PUMP.

By JOHN PARRY, F.C.S.

In the course of experiments now in hand, with the view of estimating the amount and kind of gas occluded in pig-iron, &c., it was thought necessary to heat the iron with oxide of copper *in vacuo*, and it was found that accurate carbon determinations could be made as follows:—

(1). Digesting the metal in solution of $CuSO_4$, filtering and washing residue of precipitated copper mixed with the carbon through asbestos.

(2). The dried residue mixed with about 50 grms. pure oxide of copper, and placed in a combustion-tube sealed at one end and drawn out at the other, the drawn-out end being fitted into a water-joint connected with the pump, as shown in Frankland and Armstrong's Memoir (*Chemical Journal*, vol. vi., p. 90). A vacuum being first formed, the tube was heated to a red-heat until gas ceased to be evolved. The gas was collected in a carefully-calibrated gas-tube, and measured with the usual corrections for temperature, pressure, and moisture, the amount of carbon being calculated from the number of c.c., measured according to Bunsen. Several trials were made with iron direct mixed with CuO, but all failed to give the full amount of carbon.

A sample, ascertained to contain 3·2 per cent carbon, kept heated under pump for more than 12 hours, gave only 2·97 carbon, with CO_2 gas still being evolved. Other trials—heat kept on from 2 to 4 hours—gave 2 to 2½ per cent carbon.

It was found, in all cases, that the gas given off *in vacuo* consisted entirely of pure CO_2, but that care was necessary to insure the perfect purity of the CuO used and freedom from dust.

Expt. 1.—*A* grey pig-iron. 1 grm., heated 1 hour under pump, gave 59·8 c.c. CO_2 = carbon 3·206 per cent; ditto, by ordinary combustion with CuO in current of O, carbon (1) 3·280, (2) 3·264. To experimentally test the calibration of the gas-tube a light glass flask, about 100 c.c. capacity, was fitted with a capillary tube and glass stopcock. This was connected with the pump, and, the air having been exhausted the stopcock was closed, the apparatus detached from the pump, and weighed. By passing the capillary tube up the tube containing the gas, and opening the stopcock, the CO_2 gas was drawn into the flask.

First weight exhausted flask ..	23·274 grms.
Second weight with CO_2 drawn in	23·333 ,,
CO_2	0·059

Carbon 3·206 per cent.

Expt. 2.—Another sample grey pig-iron. (1). Ordinary combustion, carbon 3·600 per cent. (2). Under pump, gas pumped direct into weighed KO bulbs, carbon 3·654 per cent.

Expt. 3.—It being thought probable that by ordinary combustion CO_2 might be retained in the oxide of copper, 1 grm. of *A* grey pig-iron was treated with solution of $CuSO_4$, washed, &c., mixed with CuO, and placed in a combustion tube, drawn out so as to admit of detaching the O-generating apparatus, and, readily sealing the end in the blowpipe flame, gave carbon 3·228 per cent. The O apparatus was detached, the tube sealed up and allowed to cool; when cold the tube was attached to the pump, exhausted, and again heated. A considerable quantity of gas was given off, which was found to be pure O, without the slightest traces of CO_2 and CO.

Expt. 4.—Puddle bar, described as being thoroughly puddled iron. Ordinary combustion, carbon (1) 0·143 per cent, (2) 0·131 per cent. Combustion *in vacuo*, carbon 0·1465 per cent.

Expt. 5.—Wrought-iron armour-plate. Combustion *in vacuo*, carbon 0·1426 per cent.

Expt. 6.—Steel. Combustion *in vacuo*, carbon 0·2972 per cent. Eggertz's colour test, carbon 0·2800 per cent.

It appears, therefore, that the ordinary combustion method with CuO in O gas gives fairly accurate results. The author is, however, of opinion that more *sure* results may be obtained by the use of the Sprengel pump; and although the method appears more tedious, and requires some manipulative skill, yet, if the pump be properly fitted up and the gas-tubes carefully calibrated, combustions may be made with great facility.

Ordinary combustions require the undivided attention of the operator, and, from the number of parts, considerable care in guarding against leakage; moreover, the KO bulbs present a considerable surface for the deposit of dust and moisture.

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[*] "Sur les Bolets Bleuissants, &c.," Bruxelles, *Journ. de Med.* 1860 (and, same year, *Comptes Rendus*, Paris, "De la Présence de 'Aniline dans certains Champignons.")

[†] *Journ. of the Chem. Soc. Lond.*, May, 1872, p. 424.

With the pump, the vacuum once being secured and preserved to the end of the combustion, there is no fear of error from leakage, and the operator—having the CO_2 gas in the tube—can leisurely verify his measurements, &c., and also test the gas for CO_2 by passing up a potash ball, and, provided pure CuO is used and the combustion-tubes are clean, can absolutely depend upon first results. As far as the author's experience goes, such is not the case by the ordinary method.

When a careful determination of carbon in steel or wrought-iron is required, two trials must always be made; the writer, as a rule, makes three determinations by the old method.

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ON CERTAIN NEW PHENOMENA IN CHEMISTRY.*

By VERPLANCK COLVIN.

The subject of this paper is so broad and varied, the phenomena so interwoven and connected with different branches of material science, that the title is but a slight index to its character, and the paper itself can be only a brief statement of facts, with such deductions as may seem to follow. It might have been entitled "An Account of Mercury and its Amalgams." As that, however, is not exactly the scope of the paper, nor the final object of it, but only the means or vehicle of communicating some ideas—which I hope will prove to be new—it may be allowed to stand here as a suggestion as to the character of the matter which is to follow.

With the discovery, by Sir Humphry Davy, of the metals of the alkalies and earths, a new era opened in chemistry. The sombre clouds which non-experimenting theorists had cast around the science were suddenly and violently dissipated in the blaze of simple truth, and one of those epochs occurred which must from time to time recur, as man acquires mastery over matter. As the theories of Stahl and his *phlogiston* had been pressed down and swept away by the discoveries of the previous century, so the accumulated errors of the intervening age were overthrown by Davy's investigations, and the new metals were evolved by electrolysis in the form of amalgams or compounds with mercury. A few of the metals of the earths, however, could not be thus procured, and their existence was only rendered probable by the analogous action of their salts or oxides when under similar treatment. These discoveries not only gave to chemistry a list of new metals, but with every one actually evolved a new amalgam. Thus, to the list of amalgams known to the ancients, were added numerous new compounds, while the general character of the elements so associated was of the most dissimilar kind. One property only seems peculiar to the majority of them, softness or malleability, and ductility. To this class of easily amalgamated elements belong such old metals as gold, silver, copper, tin, and lead; and such new metals as potassium, sodium, and calcium.

The other class of metals is peculiar in combining but slightly or not at all with *pure* mercury; and these metals, like those in the preceding class, seem to have but one general characteristic, the reverse of that of the first class, hardness, and at times even brittleness.

Iron, probably, alone of all the metals known to the ancients, belongs to this second class; while of the new metals which seem to belong to it, chromium, columbium, titanium, manganese, zirconium, and perhaps rhodium, are examples. Singularly enough platinum and aluminium, malleable and ductile metals, appear to be attached to this class by reason of the difficulty experienced in directly combining them with pure mercury. It is therefore plain that the proper classification of metals as regards their affinity for mercury is their separation into these two divisions; the *first* consisting of metals that readily combine with pure mercury; the *second* consisting of metals which refuse to combine with pure mercury, at a moderate temperature.

One of the consequences of the discoveries of Sir Humphry Davy, was the application of the amalgams of potassium and sodium to purposes of exploration in chemistry. Berzelius and Pontin obtained their ammonium amalgam by the direct electrolysis of aqua-ammonia in contact with mercury. But afterwards it was observed that this amalgam could be made by the action of potassium or sodium amalgam upon chloride of ammonium. It has been stated that the amalgams thus procured are not exactly similar, the amalgam prepared by the method of Berzelius having a composition according to H. Davy of one part of ammonium to 753 of mercury, and crystallising in cubes when cooled to zero centigrade; while that prepared with the aid of potassium and sodium amalgam contains according to Gay-Lussac and Thénard, one part of ammonium to 1800 parts of mercury.

The discovery by Graham of the metallic nature of hydrogen gas, as evinced by its occlusion in, or alloys with, palladium and platinum, enables us to avoid the difficulty of believing in the existence of a metal or "element compounded of gases"—which is an hibernicism—by supposing ammonia to be an alkaline nitrogen salt of the metal hydrogenium. Then, allowing that the light cellular or frothy state of the so-called ammonium amalgam is owing to the existence throughout the mass of molecules of released nitrogen, clinging to, and re-combining with, the rapidly re-oxidising hydrogenium, we account for the ammoniacal gas afterwards given off. We might then suppose that hydrogenium is the metal of the volatile alkali, ammonia, having little resemblance to magnesium, which Graham believed to most resemble it. This, however, is only an hypothesis, and is indeed a digression.

The potassium and sodium amalgams enable us to form, besides this hypothetical amalgam, compounds of mercury with those metals which I have arranged in a second class, as refusing to combine with pure mercury at a moderate or low temperature. The process is simply placing potassium amalgam, or its substitute, excited with some corrosive gas, solution of a salt, aqua-ammonia, water or acid (as the case may require) in contact with the metals to be amalgamated. A triple amalgam of mercury, potassium or sodium and "ammonium" (hydrogenium?) is sometimes useful; and I have found zinc amalgam, excited with chlorhydric acid, a powerful agent in producing these results.

And now, before proceeding to describe those phenomena of the discovery of which I can find no record, it is advisable to examine into the nature of mercury and its amalgams, and the present state of our knowledge of its compounds.

Remembering that the fluid mercury with which we are familiar is but the molten substance of a solid ductile and malleable metal, we arrive at the conclusion that amalgams are simply the *alloys* of mercury, as metals dissolved in melted lead would be alloys of lead. Now the alloys of mercury are peculiarly easy to examine; for even when in the fluid state they do not burn one's fingers, and by analysing amalgams we are able to discover the condition of the metals contained in them. Having prepared an amalgam of gold and dissolved it in an excess of mercury, I treated the fluid amalgam with nitric acid. When the quicksilver had entirely dissolved, there remained a small spheroid of gold, dark upon the surface, and when broken apart under the hammer, exhibiting a radiating crystallisation like that of globular iron pyrites. This, and other experiments (which I have not time to describe), appear to prove that a metal when amalgamated is really dissolved; and it is possible that if the reduction of the amalgam had been less rapid, a well-formed crystal of gold might have been obtained. The metals of the second class seem also to be actually dissolved in the mercury.

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* A Paper read before the Albany Institute.

Our knowledge of the compounds of mercury, as derived from the latest standard works on chemistry, is singularly imperfect. Ste.-Claire Deville, the famed chemist of the late French empire, the discoverer of the economic process of aluminum manufacture, asserts that metallic aluminum is not susceptible of amalgamation. Prof. W. A. Miller, in his "Inorganic Chemistry" (third edition, p. 425) also says of aluminum:—"It does not combine with mercury." Yet in Watts's "Dictionary of Chemistry," published in London three years previous to this record in Miller, we find that, "According to Cailletet (*Comp. Rend.*, 44, p. 1250) aluminum (also iron and platinum) may be superficially amalgamated by contact with ammonium or sodium amalgam and water; also when immersed in acidulated water, in contact with metallic mercury, forming the negative pole of a voltaic battery." This, published in London, 1865, appears to ante-date the discovery of the method of amalgamating aluminum with the aid of sodium amalgam by some two years; but both discoveries are obviously genuine. Again, both Miller and Watts seem not to be aware of any method of combining mercury directly with metallic platinum, in the form of foil or wire, and describe an indirect method of obtaining it, by the electrolysis of chloride of platinum. Yet potassium or sodium amalgam will readily effect the combination. A few years since, while experimenting with the amalgams of the alkaline metals, I observed that a common iron nail which happened to fall into the amalgam, became coated with mercury. For a time I believed myself the discoverer of iron-amalgam, but on examination I have found mention of it more than thirty years upon record. Aiken (*London Phil. Mag.*, xiii., p. 416), shows that it may be accomplished with the aid of zinc amalgam and a solution of chloride of iron. Watts says (*l. c.* iii., p. 887), "Mercury and iron do not unite readily. A viscid amalgam is, however, obtained by immersing sodium amalgam, containing one per cent of sodium, in a clear saturated solution of ferrous sulphate. Joule (*Chem. Gaz.*, 1859, p. 339; *Chem. Soc. Journ.*, xvi., p. 378), has obtained amalgam of iron by electrolysis of a solution of ferrous sulphate, the negative pole being formed of mercury." None of these authors appear to be aware of any method of directly amalgamating iron, yet H. Davy distinctly states that either potassium or sodium amalgam will effect the union of mercury with iron and platinum.

Mercury has been employed from time immemorial, in separating the precious metals from their earthy associates. Originally the *pure* metal was employed, as indeed it still is to a considerable extent, held in little rifts or gutters in the trough or sluice where they washed the auriferous sands or pounded ore. This was also the method of amalgamation at the stamp-mills, and it is notorious that much gold passed over the mercury in this process, and escaped. Recently I observed in the gold mining regions of the Rocky mountains, at Central city and Nevada, Colorado, that for the rifts and gutters filled with mercury, they had substituted sheets of copper, superficially amalgamated, over which the ore reduced to a thin mud, or muddy water, was washed, its gold parting and adhering to the surface of the amalgamated copper, and doing so more readily than it would to the surface of pure mercury.

Here we have another instance of that *combination-action* which we have already noticed in the potassium and sodium amalgams, as evinced by their power to unite mercury with the metals of the second class. It appears that those metals of the first class which are softest, lightest, and most easily oxidised (as potassium, sodium, zinc, &c.), have the power to enable the harder, heavier, and least oxidisable metals of the same class (as copper, silver, and gold), to combine more readily with mercury than they would unassisted; and, further, to enable mercury to combine with the metals of the second class, which though generally harder and more brittle than any of the preceding, are often readily oxidised. This *combination-action* separates the alloys of mercury from all other alloys, so far as we now understand them; for, as I have already shown, instead of the mercury always losing power as a metal solvent in proportion as it becomes alloyed—it shows a preference,—and when combined with portions of the readily oxidisable metals, becomes more active and indeed almost ferocious in its appetite for the metals and alloys that are of a highly electro-negative character; while if alloyed with sufficient gold or silver in the first instance, it appears satisfied, phlegmatic, and indifferent to further metallic food. Experiments which I have made demonstrate that cyanide of potassium *does not* answer as well as the amalgams of the alkaline metals, in effecting the union of mercury with electro-negative metals, as some have asserted. Its solution is, indeed, not more effective than aqua-ammonia in producing such results, and what efficacy either of these solutions possess may be attributed to their cleansing the surface of the metal to be amalgamated.

It now becomes evident that the separation of metals into the two classes is incorrect, as we have here, as in every other general classification in science, no absolute division, but merely extremes and means; the true mean being difficult to determine. The reactions of these amalgams of the electro-positive metals with those metals which are relatively electro-negative, are very instructive. They tend to prove that all the amalgams subsequently formed are the results of *electrical action*, to induce which we have only to place a particle of iron in contact with potassium amalgam and with water. In an instant we have a voltaic battery in active operation; the amalgamated potassium forming the "zincode," while the iron is the electro-negative element of the battery. Of the metals present the mercury is the electro-mean, and with the oxidation of the potassium, it passes over to and effects a combination with the iron.

Thus we arrive at a more correct classification, and at a law of preference of metals and alloys for mercury:—

1st Law.—Metals that are easily alloyed with mercury give place to and assist the less amalgamatable metals in combining with mercury, when in the presence of an acid or corrosive liquid or atmosphere, which attacks the metal already amalgamated, and which does not attack, or does not so violently attack, the metal to be amalgamated.

2nd Law.—The more intense the action of the acid or corrosive liquid or gas upon the metal in the original amalgam, the more rapid the formation of the secondary amalgam.

3rd Law.—The amalgams of electro-positive metals assist those metals which are relatively electro-negative in combining with mercury.

These laws are the results of certain experiments which, as examples, I will now proceed to describe and illustrate. Placing before us mercury—1st, in the pure state; 2nd, amalgamated with copper; 3rd, zinc amalgam; 4th, aluminum amalgam; 5th, sodium amalgam; 6th, potassium amalgam; and 7th, "ammonium amalgam" (hydrogenium?)—we may suppose that we have the extremes and some of the means of mercurial power; mercury in the *pure passive* and in the compound induced *active* state. To prove that it has a passive and an active condition, it is only necessary to exhibit gold leaf before the pure mercury and each of the several compounds mentioned.

First.—It will be seen that with mercury alone it does not readily amalgamate, and there is no attraction of the gold leaf toward the metal.

Second.—Held above the amalgamated copper there is no attraction, but the moment the gold is allowed to touch the surface, it is eagerly seized and devoured.

Third.—Held above zinc amalgam excited with chlorhydric acid, the gold leaf begins to waver and tremble slightly as though influenced by the amalgam. Touched to the amalgam it is seized and vanishes instantly.

Fourth.—Above the sodium amalgam, excited with water or aqua-ammonia, we have the same symptoms, but even more excitement and eagerness on the part of the gold leaf to pass to the amalgam as it is approached; and the gold is scarcely touched ere it is gone, licked up by the hungry amalgam.

(This action is only seen when but short distances intervene between the gold leaf and amalgam, an eighth or sixteenth of an inch. To perform the experiment successfully, the water should just cover the amalgam, and the edge of the gold leaf should be allowed to dip a little into the water.)

Fifth.—With potassium amalgam the action is greater.

Sixth.—With the hypothetical hydrogenium or ammonium amalgam, I have found *less action* than the supposedly high electro-positive character of the metal (?) would indicate. This might be accounted for by the porous condition of the amalgam, owing to the gas contained (nitrogen?) and consequently much diffused state of the "metal." I notice this last experiment and reaction merely because it may be valuable in determining whether such gaseous metals exist.

The result here seems to be that we have now for the first time a metallic compound capable of attracting the precious metal gold, when but a short distance intervenes. We can amuse ourselves with the idea that upon this principle a compass may be constructed (a tube charged with the amalgam), which will be to the prospector and gold hunter as the magnetic dip needle is to the searcher after iron ore. Still, there is something inexplicable about it, for this apparent attraction of gold can hardly be magnetic, and it seems to me we must look for explanation to cohesive molecular power.

I have shown that the combination of mercury and iron was long since effected; I have now to claim as a discovery the direct amalgamation of *steel*, even when of the toughest and hardest character. The blade of the best pen-knife is readily amalgamated, and suffers from the contact, while a plate of fine sheet steel, used in the manufacture of superior instruments, is easily coated with mercury and made to resemble a sheet of silver. By magnetising soft steel, reducing a sufficient amount of it to filings, and dissolving the filings in mercury, I have procured a magnetic amalgam, in the presence of which an astatic needle is decidedly bewildered. The horseshoe magnet which has this evening been exhibited brightly coated with and upholding an inverted arch of fluid, dripping mercury, lifts quicksilver, it is true, but quicksilver loaded with an amalgam of magnetised steel; an attraction much stronger than that evinced for iron amalgam.

A glass tube properly charged with the magnetic amalgam exhibits the polarity of the compass needle, and has its extremities attracted and repelled by the poles of the magnet in the same manner that the poles of the compass needle are attracted and repelled. This property of the magnetic amalgam is interesting, as it proves that however minutely divided, the atoms of steel still retain their magnetism, and are still influenced by the directive currents of the earth. I have not yet been able to make a very powerful needle of this kind; but, though my observations are very imperfect, I am able to say that it seems to point a little more truly to the magnetic north, and from its greater inertia to be less subject to irregular changes of variation than the ordinary compass needle. The inertia is to be attributed to the assumption by the magnetised steel of a certain portion of the weight or specific gravity of the mercury. When this amalgam is exposed to the oxidising influence of the atmosphere, it is gradually decomposed, carbon being liberated, and the permanent magnetism vanishing, while iron amalgam remains. This will also finally decompose, pure mereury and ferrous oxide resulting.

Another discovery that I may claim, is the direct amalgamation of *cast-iron*, even of the most brittle and highly carburetted character. This was first effected by means of a compound amalgam of potassium, sodium, and "ammonium" with water; but I have since found that a simple amalgam of potassium or sodium is generally sufficient to effect the result. The surface of cast-iron may be amalgamated by placing an electro-positive or active amalgam upon it with water or an acid; a true amalgam may be similarly formed with filings.

In the course of the experiments which led to this discovery, it was my fortune to observe phenomena of an extraordinary character. The usual brilliant surface of mercury is produced when cast-iron is treated with the electro-positive amalgam, and the iron is rapidly "cut" or dissolved. The impurities of the iron, with considerable carbon, are released and form a black mud around the button of amalgam. If at this moment, before all the positive metal has been oxidised, the amalgam be removed, washed, and allowed to stand, particles of amorphous carbon will be seen to emerge and float upon its mirror-like surface. Whence comes this carbon; why was it not given up before? Has it been amalgamated; and if so, has it not a metallic character? It has been suggested to me that particles of undissolved iron, containing carbon, have been carried bodily into the amalgam, and afterwards dissolved, releasing their carbon. However, this is but a conjecture; the reaction certainly deserves study.

The mere intimation that carbon, the great protean thing in nature, may, after all, have a metallic origin, is very interesting. Those who believe in the ammonium of Berzelius or the hydrogenium of Graham, need not fear to examine the claims of carbon to a metallic parentage, nor does the existence of such a metal seem so improbable when we remember the electric conductibility of two of the allotropic forms of carbon, gas-coke and plumbago; the first already replacing, in the voltaic batteries of the present day, the electro-negative elements, platinum, copper, &c., while the latter replaces similar electro-negative elements when brushed, in the form of plumbago powder, upon the surface of the mould or plaster-cast which the electroplater desires to coat with copper or other metal.

If metallic carbonium exists, it may be assumed to be an electro-negative metal. It is true that some forms of carbon are highly inflammable, but are they more so than Graham's hydrogenium? Graphite at ordinary temperatures is far from combustible, and when it burns, or when the diamond burns in oxygen gas, wrought-iron will burn also. No one doubts that iron is a metal, yet one of its purest forms is pyrophoric, taking fire and burning on contact with the atmosphere. To associate graphite with sulphur and phosphorus is to place it, a good conductor of electricity, side by side with the very enemies of travelling magnetism. For how many ages was molybdenite undistinguished from graphite, and who is there now that can instantly distinguish the one from the other? It is true that molybdenite is a sulphide of molybdenum, and graphite a pure allotropic form of carbon, but may there not be one more form of carbon? There is no substance in nature more readily recognised as a metal by the unlearned than graphite; to this day it is impossible to take from it the improper title of black-lead. The experiments of Sir Benjamin Brodie with graphite, his discovery of graphic acid and its combination with ammonia (*graphate of ammonia?*) afford another analogy; for molybdenum has its molybdic acid, and what chemist is there that is not familiar with *molybdate of ammonia?* I have found that contact of native graphite with an electro-positive amalgam and water or acid, produces the same reaction and effervescence as when a negative metal occupied the place, but an amalgam did not seem to form.

It would appear that the division of elements into metals and non-metals is as arbitrary as any other absolute division or classification in science; for though the extremes may readily be distinguished,—as gold from fluorine,—the means often approach each other in appearance and in properties.

Besides forming amalgams of steel and cast-iron, I have succeeded in combining mercury directly with crystalline octahedral iron ore (*magnetite*), and with other ores and some furnace products. The loadstone exhibited, coated with mercury, is from the Adirondack mountains. Red fossiliferous hæmatite ore from Georgia is also readily amalgamated. Bog-iron has so far resisted mercury, save one specimen from the state of Florida, which appeared to receive it slightly. The *slag*, &c., of the Colorado gold-smelting furnaces may also, by means of the compound amalgam, be coated with mercury. Magnesium may be amalgamated with the aid of zinc-amalgam and chlorhydric acid; much heat is evolved, sufficient indeed to burn the hand if laid upon it. Bisulphide of carbon, treated with the compound amalgam, is decomposed; sulphides of the alkaline metals result, while another portion of sulphur combines with the mercury, forming true vermilion. Carbon separates in form resembling graphite.

The practical applications of these discoveries are numerous. As mercury dissolves iron and its ores, and finally separates the metal from its impurities of silicon, sulphur and phosphorus, it may prove possible to prepare an iron, nearly as pure as that reduced by hydrogen, for medicinal purposes, by distilling the mercury from the amalgam. In accordance with the laws announced, it is evident that plates of amalgamated zinc or iron are superior to plates of copper in effecting the amalgamation of gold, especially if they be treated with proper acid solutions while the stamped ore is being run out over them. Potassium and sodium amalgams are undoubtedly more effective, but can hardly compete with amalgamated zinc-plates in cheapness.

A great philosopher has said that the results of all experiments should be recorded, nothing being worthless that adds to man's knowledge of the properties of matter. It is my hope that the experiments described, and suggestions here thrown out, may not be altogether valueless.

ON THE ZIRCONS OF CEYLON.*

By M. H. COCHRAN, F.C.S.

The natural silicates of zirconium have of late attracted great attention among chemists by reason of the researches of Messrs. Sorby and Forbes, and on account of the discovery of a supposed new earth associated with zirconia in these minerals.

Many chemists have held the opinion that zirconia was in reality a mixed earth. Svanberg in 1845 announced the discovery of a new element, to which he gave the name norium, in zircons and jargons from Ceylon and Siberia, but as he did not make known the results of any further researches on it, the existence of norium was rendered doubtful.

Mr. Sorby, in 1869, announced the discovery, by means of the micro-spectroscope, of an earth having a totally different absorption spectra from that of any known element, and he succeeded in separating the new earth from zirconia. Mr. David Forbes, at Mr. Sorby's request, made a chemical analysis of Ceylon jargon, and he also succeeded in separating the other earths from zirconia by taking advantage of the insolubility of zirconium chloride in concentrated hydrochloric acid.

Having through the kindness of a friend obtained seven small specimens of jargon and zircon from different localities, I analysed them by the same process which Mr. Sorby adopted.

The finely-powdered mineral was fused thoroughly with a mixture of equal parts of carbonate of soda and carbonate of potash until the silicate was decomposed, a little caustic potash being dropped into the centre of the fused mass towards the end of the process. This was then treated repeatedly with boiling water, and the silica estimated in the solution in the usual way. The residue contained all the zirconia; it was tested carefully for silica, but was found completely free from it. It was then once more evaporated to dryness with hydrochloric acid, and the residue treated repeatedly with concentrated hydrochloric acid, which dissolved out a small quantity of sesquioxide of iron, and also the other earth accompanying zirconia, to which Mr. Sorby gives the name jargonia. The residue after this treatment was dissolved in water, and the zirconia precipitated by ammonia and weighed, and called A.

To the hydrochloric acid solution ammonia was added, then tartaric acid in excess; a portion of the precipitate at first formed was dissolved, but a quantity remained undissolved; this was washed, dried, ignited, weighed, and marked B; when examined with the micro-spectroscope it was found to have a spectra different from that of any known element.

Ammonia was added to the tartaric acid solution, then sulphide of ammonium, when, after the lapse of some days a precipitate of sulphide of iron was formed; this was collected, converted to sesquioxide of iron, and weighed. After separation of the iron the solution was evaporated to dryness in a platinum basin and ignited strongly for some time, when a residue was left, which appeared to be a third earth; this was marked C. Mr. Forbes's analysis yielded the following numbers:—

Silica	33·61	per cent.
Zirconia A.	46·12	,,
,, B.	7·64	,,
,, C.	12·62	,,
Sesquioxide of iron ..	0·24	,,
	100·00	

I adopted exactly the same method, but except in one instance everything was precipitated at the stage A, and I could not succeed in obtaining any other earth than zirconia.

The first specimen examined was a jargon from Ceylon; it was almost colourless. 0·9320 grm. yielded on analysis—

Silica	0·316
Zirconia..	0·604

Or, when calculated to per cent—

Silica	33·90
Zirconia..	64·80

It contained no iron.

The second specimen was a pale yellowish hyacinth, also from Ceylon. 0·733 grm. gave—

Silica	0·241, or 32·87	per cent.
Zirconia	0·471, or 64·25	,,
Ferric oxide.. ..	0·015, or 2·04	,,

The third was a Norwegian zircon, and was of a dark brownish yellow colour. 0·701 grm. gave—

Silica	0·228, or 32·53	per cent.
Zirconia	0·449, or 64·05	,,
Ferric oxide.. ..	0·020, or 2·85	,,

The fourth specimen was an almost colourless Ceylon jargon. 0·655 grm. gave—

Silica	0·2165, or 33·05	per cent.
Zirconia	0·4370, or 66·71	,,

It had only the merest trace of iron.

The fifth was also an almost colourless jargon from Ceylon. 0·503 grm. gave—

Silica	0·1710, or 33·86	per cent.
Zirconia	0·3245, or 64·25	,,
Ferric oxide ..	0·0055, or 1·08	,,

The sixth sample was a Norwegian zircon. It had a dark brownish yellow colour, and was almost opaque. 0·5 grm. gave—

Silica	0·1680, or 33·61	per cent.
Zirconia	0·3200, or 64·40	,,
Ferric oxide	0·0045, or 0·90	,,

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* Read before the Glasgow Philosophical Society.

The seventh specimen was a Ceylon jargon, and it was perfectly clear and transparent. 0·488 grm. gave on analysis—

Silica	0·1650, or 33·81 per cent.	
Zirconia A	0·2835, or 58·29	,,
,, B	0·0390, or 8·03	,,

It contained a faint trace of iron. The substance marked zirconia B was examined with the micro-spectroscope in the manner described by Mr. Forbes in the Chemical News, April 30, 1869; but was entirely unsuccessful in detecting any peculiar absorption-bands. In appearance, and apparently in all its properties, it was exactly the same as the zirconia A. From my examination, therefore, I am inclined to doubt the existence of the so-called jargonia, as I believe the zirconia A and B to be identical.

EXPERIMENTS ON DISINFECTANTS.

A special commission was appointed by the Academy of Sciences, at Paris, to study the different means of disinfecting those localities which, during the siege, had been appropriated to persons afflicted with contagious diseases. Its report furnishes some useful guides to the selection and the application of disinfectants.

The report assumes, in the first place, the germ theory of infection.

Placing in the same rank chlorine and the hypochlorites, which effect a veritable disinfection by decomposing the infected gases, and carbolic acid, of more recent application, which prevents or arrests putrid fermentation by destroying the vitality of the principal living agents of the fermentation, the commission compared the effects obtained with those which one might expect from very energetic chemical agents, capable of burning up or otherwise destroying the germs.

The commissioners agreed that the very first place among destructive agents which can attack and destroy infectious germs, should be assigned to hyponitrous acid. Great precaution should be exercised, however, by those employing the very dangerous nitrous vapours. Doors, windows, and the fireplace, should be carefully sealed with gummed paper. The following are the proportions and the quantities of materials to be employed per 30 to 40 cubic metres:—Water, 2 litres; ordinary commercial nitric acid, 1500 grms.; copper turnings or shavings, 300 grms. Earthenware vessels of 8 to 10 litres capacity are employed, one for 30 to 40 cubic metres of space. The exit door is carefully sealed, and the room exposed to the fumes for 48 hours. The person who opens the room must be protected by some means, such as the apparatus of Galibert. Carbolic acid is much more easily applied, is less dangerous and expensive, and seems to offer guarantees of quite equal efficacy, founded on experimental evidence. It is best employed by mixing with sand or sawdust, in the proportion of 1 kilo. of acid and 3 kilos. of the inert material. The mixture is placed in earthen pots, as above, and under the same conditions. Carbolic acid, diluted with 25 to 30 times its weight of water, was found very useful in sprinkling daily the floors and the bedding of sick chambers.

An interesting case is cited, where chlorine and the hypochlorites were powerless to destroy or to transform into inodorous products the gases given off by the bodies at the Paris Morgue during the heat of summer. Only one course remained, and that was to destroy the active sources of the gaseous products. This was accomplished by dissolving a litre of liquid carbolic acid in the reservoir of 1900 litres fresh water, which served to sprinkle the bodies. The suppression of putrid fermentation was complete.

It has been stated, by M. Devergie, that water containing only the $\frac{1}{4000}$th part of its weight of carbolic acid sufficed for the disinfection of the dead-house, during the hottest weather, when it contained from six to seven bodies.

The following is the method of fumigating, with chlorine, the linen, mattrasses, and other bedding, according to the latest recommendations of M. Regnauld:—

In a strong canvas bag, of 1 litre capacity, introduce 500 grms. chloride of lime (a mixture of hypochlorite of lime and chloride of calcium, usually at 100°); then sew up the bag. The latter is then placed in an earthen pot containing 1 litre of common hydrochloric acid, sp. gr. 1·15, and 3 litres of water; as soon as the chloride comes in contact with the acid the room is closed, and the goods are left exposed to the chlorine fumes for 24 hours; the room is afterwards ventilated during 48 hours. Ten earthen vessels, as above, disengage 500 litres of chlorine, sufficient to disinfect 20 to 25 mattrasses more or less contaminated.—*Le Bulletin du Musée de l'Industrie.*

ON THE PURIFICATION OF SUGAR SOLUTIONS FOR THE OPTICAL SACCHAROMETER.

By P. CASAMAJOR.

In the *American Chemist*, April, 1871, p. 378, is an article by Dr. Stammer, taken from the *Sugar Cane*, on the use of animal charcoal in purifying saccharine solutions for polarimetric analysis. The conclusion which is drawn from the experiments detailed in the article is that animal charcoal absorbs sugar from its solutions, and cannot therefore be used for clarifying saccharine solutions for analysis. This conclusion is certainly interesting in a scientific point of view, but hardly less so in its practical bearings to the sugar manufacturer and refiner. It is a matter of such importance that it cannot be accepted without incontrovertible proof, even if supported by such authority as the name of Dr. Stammer.

After making a great many experiments, I am in a position to state that *animal charcoal does not absorb sugar from its solutions* in the same manner as it absorbs colouring matter, salts of lime, magnesia, iron, &c.

The proof of this I have obtained by eliminating with care every source of error, and repeating the experiments several times with different sugars.

I have proceeded as follows:—In the first place, a solution was used of a sugar light enough to give a liquid fit for the saccharometer with acetate of lead, but without using animal charcoal. This solution was placed in the saccharometer, and the result obtained noted.

This same solution was afterwards filtered over animal charcoal containing 3·8 per cent of water. The saccharometer indicated 2 per cent less of sugar.

Another portion was filtered over animal charcoal containing 8·8 per cent of water. The saccharometer indicated a loss of 5 per cent.

For instance:—16·35 grms. of a light-coloured sugar was dissolved so as to occupy 100 c.c. The solution, after treatment with subacetate of lead, was of a slight yellow colour. The saccharometer indicated 90 per cent. With the portion filtered over animal charcoal containing 3·8 per cent of water, the saccharometer indicated 88 per cent. With the portion filtered over animal charcoal containing 8·8 of water, the saccharometer indicated 85 per cent. These results show that the presence of water in the bone-black will affect the strength of the solution.

The next step was to filter the saccharine solution over perfectly dry animal charcoal. This was obtained by heating animal charcoal for over two hours over a lamp, at 350° F., and *throwing the black, while hot, into a hot and dry bottle.* Immediately afterwards the bottle was hermetically closed.

When this dry black is used no loss of sugar is shown by the saccharometer. There cannot be an error in this, as the experiment was repeated several times with the same uniform result.

It has been stated that the conclusion of Dr. Stammer is, that animal charcoal absorbs sugar from its solutions. If, however, we examine attentively the table from which this conclusion is drawn, we shall notice that the differences between the percentages of sugar, before and after filtration, are very small, varying from 0·2 of 1 per cent to 0·6 of 1 per cent, except in cases where bone-black was used in large quantities, twice or three times as much as in the greater number of cases. The time of contact of the bone-black with the saccharine solution does not seem to have had any influence on the pretended absorbing power of animal charcoal for sugar. These times of contact vary from 3 hours to 24 hours, but the pretended quantities of sugar absorbed vary independently of these times. The variations when they occur are less than ½ per cent. Nobody who has experience in tests by the optical saccharometer needs to be told that such variations must necessarily take place, even on testing the same solution twice in succession, particularly if it is not perfectly colourless.

In examining the two tables, it seems strange that there is so little difference in the comparative results, as the experiments of Table 1 were made with animal-black that had been heated at 230° F., and those of Table 2 with animal-black that had been heated at 350° F. Bone-black heated at 230° F. does not lose all its water. The water remaining in the black, heated at 230° F., will certainly affect the strength of the solution, and produce an apparent absorption; while bone-black, heated long enough at 350° F., loses all its water, and will not affect the strength of the solution. That the portions mentioned as absorbed are very nearly alike in both tables, except when larger quantities of bone-black are used, shows that the bone-black was not kept perfectly dry.

It is of the utmost importance to use bone-black that has been *kept dry in a closed bottle*. If the bone-black is allowed to cool in the open air it very quickly absorbs moisture. If used hot it increases the temperature of the solution, and by expansion decreases the percentage shown by the saccharometer. As to putting it in the solution hot and allowing it to cool, if left for several hours, as in some of the tests in these tables, there is great danger of losing sugar by fermentation.

Instead of bone-black I use a process, to obtain colourless saccharine solutions, which has answered with all grades of sugar, and which certainly does not take any additional time, or give any additional trouble. This process is founded on the observation that the facility and perfection of clarifying a solution of sugar by subacetate of lead seems to depend on the quantity of mineral salts contained in the sugar. Thus many very dark inferior sugars, such as Manillas, will give solutions which are easily clarified by subacetate of lead, producing at the same time a dense precipitate. Such sugars give, on incineration, a large quantity of ashes. Other saccharine products, particularly those that have been filtered over bone-black, are not very dark, but subacetate of lead acts on them imperfectly, giving a slight precipitate which stops up the pores of the filters.

Acting on the above observation, I add to saccharine solutions soluble salts capable of giving dense precipitates, with subacetate of lead. I have used at different times chloride of sodium, sulphate of soda, phosphate of soda, and acid phosphate of lime, and have found them all equally effective. Other chlorides, sulphates, phosphates, iodides, &c., will doubtless give the same result.

The soluble salt is added by throwing a pinch of it on the sugar, and dissolving by water afterwards, or by putting in a few drops of a solution of the salt.

The results obtained are very satisfactory, as the solutions are quite, or nearly, colourless, whatever be the kind of sugar treated. A secondary advantage is, that the precipitate is very dense and easy to filter, while some of the sugars without the addition of the salts filter very slowly.

By a succession of experiments I have ascertained that the addition of the salts mentioned above does not affect the saccharometric percentage of the solution.

In connection with the subject of purifying sugar solutions for the saccharometer, there is an important fact, discovered in this laboratory, by Mr. Henry O. Havemeyer. When in saccharometric tests we are obliged to invert, as in tests of molasses, melados, and very low sugars, the hydrochloric acid used produces such a red colour that the solutions are not fit for the saccharometer unless we are careful not to heat them above 68° C., and to cool them as soon as possible afterwards. The inversion is often imperfect under these circumstances, and the safest way is to invert again until no change is shown by the saccharometer. If this is repeated, the red colour will appear even if the solution is not heated above 68° C., and is cooled quickly.

The important fact mentioned above is, that the addition of a small quantity of protochloride of tin will prevent the formation of the red colour, even if the solution is heated above 70° C., several times, until no variation is shown by the saccharometer.—*American Chemist.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 20th, 1872.

Dr. Frankland, F.R.S., President, in the Chair.

The minutes of the previous meeting having been read, Messrs. Patchett and G. B. Longstaff were formally admitted Fellows of the Society. The donations were then announced, and the names of Messrs. Arthur Willis and Robert Symington Grieve Paton read for the first time: for the third time—Messrs. John Emilius L. Shadwell, M.A., Walter Weldon, Walter Stewart, jun., John Ferguson, M.A., Charles Armbruster, George J. Snelus, and R. Wormell, M.A., B.Sc., who were then ballotted for and duly elected.

The President said the Fellows might perhaps recollect that, about two years ago, the Society had agreed to make grants not exceeding fifty pounds for the promotion of original research; and he now had to announce that Mr. Hyde Hills had given the sum of ten guineas for the same object, and generously offered to give other ten guineas for each ninety guineas subscribed up to five hundred pounds. He need scarcely ask the Fellows to thank Mr. Hills for his liberality in endeavouring to encourage original research. He would now ask Mr. Deacon to deliver his lecture on his "*Process for the Preparation of Chlorine.*"

The Lecturer said that about two years ago, at Liverpool, he had given an account of his process for the preparation of chlorine from a heated current of hydrochloric acid mixed with air, which since then had been the subject of a great amount of research, with the object of ascertaining how this could be effected continuously, readily, and at the smallest cost. This problem may be resolved into the following:—

1. As to the most suitable active or catalytic substance.
2. Whether the mass or the surface of the substance was the active agent.
3. As to the effect of temperature.
4. As to the best arrangement of the substance.
5. As to the effects produced by variation in the velocity of the current of gas.
6. As to the effect of various proportions of air or oxygen and HCl.

He had observed that the heated mixture of hydrochloric acid and oxygen or air does not yield chlorine, unless it is in the presence of some substance capable of being attacked by the hydrochloric acid, amongst which the copper compounds were eminently active.

Sulphate of copper was fixed upon for economic reasons: and almost all the experiments mentioned in his lecture had been made either with the pure sulphate or with pumice-stone or fragments of clay saturated with it. In experimenting, two clay tubes were generally employed, of different bores, glazed externally, and coated internally with sulphate of copper, placed side by side, and passing through the cork of a glass tube sealed at the other end. The mixed gases, on entering, first traversed the glass tube, and then passed out by the clay tubes. In the more recent experiments this apparatus was placed in a thick massive iron tube, heated externally by a furnace, so as to maintain a uniform temperature. This was measured by the change in electrical resistance of a fine platinum wire, and also by a mechanical pyrometer. The mixed gases were contained in gas-holders worked with strong sulphuric acid, both the amount of hydrochloric acid passed and the amount of chlorine produced being ascertained by passing the gases into a solution of caustic soda.

The Lecturer then explained the numerous diagrams and tabulated results of experiments with which his discourse was illustrated, from which it would appear that there is a certain comparatively small range of temperature, between the critical limits of which the percentage of hydrochloric acid decomposed varies greatly, and that this is not the same for the chloride as for the sulphate of copper, being higher for the latter, although it is the same whether solid sulphate of copper be used or merely pieces of brick saturated with it. This shows that the action is essentially a surface action. It is, however, remarkable that in experiments on a large scale this temperature is invariably lower than in the laboratory experiments, usually 100° or 150°; also, that when the mixed gases are passed through a series of parallel tubes, an increased velocity in the flow of the gas yields only about one-third the increase of the amount of chlorine produced that an irregular porous surface does under like circumstances.

From the results of all the experiments contained in the tables, the speaker inferred—

1. That with the same mixture of gases, at the same temperature, the amount of hydrochloric acid decomposed by the aid of a molecule of the copper salt, in a given time, depends upon the number of times the molecules of the mixed gases are passed through the sphere of action of the copper salt.
2. That in long tubes of the same diameter the number of opportunities of action in the same time are nearly the same at all velocities.
3. That in long tubes of different diameters the number is the same when the velocities of the currents of gas are in inverse proportion to the square of the diameters.
4. That in porous masses the opportunities of action increase with increased velocities, in nearly direct proportion.
5. That, other conditions remaining the same, the percentage of hydrochloric acid decomposed varies with the square root of the proportionate volume of oxygen to hydrochloric acid.
6. That the $CuCl_2$ formed bears no definite proportion to the amount of chlorine produced.
7. That as the sphere of action includes molecules not in contact with the copper salt, therefore hydrochloric acid must be decomposed under circumstances where the union of either element with the copper salt is impossible.

The President said he need scarcely ask them further to record their thanks to the lecturer, for the clear and comprehensive account he had given them of his numerous and interesting experiments on the mutual action of hydrochloric acid and oxygen in the presence of salts of copper. The process for preparing chlorine, at present used, was essentially clumsy and unscientific; the hydrochloric acid given off from the salt cake was first dissolved in water, and then treated with manganic peroxide in order to liberate the chlorine, giving rise, at the same time, to a large amount of waste products, which were thrown into our streams and polluted them. As especially interested in our rivers, he sincerely hoped the process would prove a commercial success.

Dr. Williamson said he would like to ask a question or two for his own information. He understood that the mixture of air and hydrochloric acid was heated before being passed into the decomposing chamber; was it cooled again before it went into the chambers containing lime for the preparation of chloride of lime, and was the undecomposed hydrochloric acid previously removed by washing?

Dr. Debus would like to know whether the sulphate of copper was found to be unaltered after having been exposed to the action of the mixed gases for a considerable time, and also whether, when he used straight tubes with the mixed gases passing through at different velocities, the gas in both instances had attained the same temperature when it came in contact with the sulphate of copper.

Mr. Stevenson remarked that he had no practical acquaintance with Mr. Deacon's process; but he thought that if the old process continued to be used, we possessed a great advantage in Mr. Weldon's method for revivifying the manganese, so that, in this revolutionary period of the manufacture, we had the benefit of both processes.

Dr. Voelcker said the lecturer had made an allusion to the action of chromium on the mixed gases in the early part of his lecture; would he, perhaps, kindly explain what was its especial peculiarity?

Dr. Gladstone observed that many interesting points started up in one's mind in connection with this subject, and he should like to know more fully why the lecturer believed the sphere of action to include molecules not in contact, and that the decomposition was not due to direct chemical action. It appeared to him that it was unnecessary to suppose the cause to be the mechanical striking of the molecules of the gas against the sulphate of copper surface, in their passage through the apparatus, and therefore depending on the flow; for it must be remembered that, when a gas was mechanically in a state of rest, the molecules composing the gas are in a state of motion, and that when we heat that gas this rate of motion of the molecules amongst themselves varies, although the gas is still mechanically at rest.

Mr. Deacon replied that it was one thing to express clearly what one had carefully thought over, and another to answer, off-hand, questions that embraced a wide field of enquiry; moreover, he had come there to speak simply on the scientific aspect of his subject, and he thought it would save the time of the Fellows present, and avoid going over old ground, if they would permit him to put aside all technical questions, and reply only to those which had a scientific interest.

In the first place, there is a definite range of temperature where chlorine is freely formed, but no chloride of copper; although at a higher temperature, the sulphate of copper is partly converted into chloride. This only applies to pure sulphate of copper, which, even after the action had been continued for six months, contained but mere traces of chlorine. In the presence of clay, however, the sulphate of copper is decomposed, and chloride formed, probably owing to its containing some base which combines with the sulphuric acid.

In the case where the exterior glass tube contained two clay tubes of different diameters, the gas coming in contact with the copper salt certainly had the same temperature, although moving with different velocities.

With regard to his allusion to chromium, he had expected—from the well-known oxidising power of chromic acid—that it would have been very active, but, on the contrary, he had found that it was reduced to oxide of chromium, which is one of the most inactive substances.

With respect to the theory he had laid before them, without vouching for its correctness, he could say that it was the only way he knew of accounting for the results he had obtained.

After a vote of thanks to the lecturer, the meeting adjourned over the recess.

CORRESPONDENCE.

MANUFACTURE OF SULPHATE OF AMMONIA—PROPOSED ASSOCIATION OF MANUFACTURING CHEMISTS.

To the Editor of the Chemical News.

Sir,—Can some reader of the Chemical News tell me whether gas-works ammoniacal liquor is distilled anywhere in England at the present day on the continuous and economical principle of Coffey's Still? If so, a brief description of the apparatus and results obtained in working would, I am sure, interest the large number of your readers connected with the manufacture of sulphate of ammonia,—certainly the great majority of whom work on the more wasteful and costly plan of boiling off in charges by fire or steam, or of evaporation to crystallising-point after saturating with acid. I know a works where plant is just about to be erected for thus evaporating 90,000 gallons per week, at an estimated weekly expenditure of 50 tons of coal!

I have been very much struck for some time back with the extraordinary isolation with which we English chemical manufacturers surround ourselves. I have repeatedly discovered gentlemen within a few miles of the works with which I am connected, blundering away at problems which have been settled here years before, and the solution of which we should have been most happy to show them, had they had the courage to ask our experience in the matter. Similarly, I confess to have found ourselves on the wrong side of methods and plans which others had elaborated, which they had no special interest in keeping secret, and the earlier adoption of which by ourselves might have saved years of time and hundreds of pounds of expense. I am persuaded that the secretiveness and isolation from our neighbours which, as manufacturers, so many of us deem it necessary to keep up, loses us vastly more than we would gain by a frequent interchange of ideas and experiences.

Let none of your readers imagine me a disciple of Mr. Macfie. I am, and always have been, a warm advocate of a Patent Law; and while I believe that there are numberless auxiliary methods and plans of a kind which manufacturers never dream of patenting (which they would be glad to exchange and reciprocate with others), I consider that nothing would so much promote the introduction of valuable patents as the periodically bringing together, for mutual interests, of the great body of manufacturing chemists.

Let it not be forgotten that the large-souled recognition of this truth by the iron-masters, in the formation of their new Iron and Steel Institute, has led directly to the adoption of the invaluable Danks furnace.

I submit to your readers that the time has come for an Association of Manufacturing Chemists, holding an annual gathering, at which the manufacture of at least the great staple, sulphuric acid, might be discussed, scientific and technical papers of general interest read, and such questions considered as the transfer of chemical works from the supervision and control of illiterate Local Board inspectors to that of the intelligent and scientific staff administering the Alkali Act. Everybody knows that the two great results of that Act have been, (1) to deliver alkali-makers from the miseries and heart-burnings of nuisance-making; (2) to compel them to make money by condensing a corrosive acid. I ask whether a similar result in other branches of manufacturing chemistry would not be infinitely preferable to the state of siege (in fact, in some districts, absolute prohibition of manufacture) now kept up by Local Boards. Other matters of daily-increasing importance, such as the rapid growth and scientific treatment of chemical manufacturing on the Continent, might be discussed with immense advantage.

Trusting some of your readers will take up other phases of the question, and that the matter will not be allowed to drop till a strong national association has been formed,—I am, &c.,

Frank.

June 22, 1872.

THE ATOMIC HYPOTHESIS.

To the Editor of the Chemical News.

Sir,—After the very positive assertions made by Mr. Atkinson (without accompanying evidence) in Chemical News, vol. xxv., p. 273, it may appear somewhat rash to continue the discussion; but with your permission I would offer a few points for consideration.

According to J. S. Mill "an hypothesis is any supposition which we may make (either without actual evidence, or on evidence avowedly insufficient) in order to endeavour to deduce from it conclusions in accordance with facts which are known to be real." And he goes on to say that an hypothesis for verification requires it to be shown, in the first place, that from it the known facts may be deduced; and, in the second place, that *they can be deduced from no other*. Now, even if the first requisite be admitted in the case under discussion, I am not aware the second has been attempted, so it would seem that the atomic hypothesis is still unverified.

Mr. Atkinson's argument, that the law of multiple proportions cannot exist apart from the atomic hypothesis because it is not in exact accord with experimental results, appears to me to be equally opposed to the hypothesis, unless the latter can be supported by *extra chemical evidence*; for, as far as chemistry is concerned, it depends on precisely the same kind of experimental results, and is in no closer accord with them than is the law of multiple proportions. Indeed, I might have said on *supernatural* evidence, for all natural laws have experimental bases.

Turning to the historical side of the subject, I think it may be shown that Dalton discovered the law of multiple proportions before he devised the atomic hypothesis. In his earliest chemical memoir, in 1802, he says "the elements of oxygen may combine with a certain portion of nitrous gas, or with twice that portion, but with no intermediate quantity." His first table of atomic weights was read in 1803, a year later, and is most clearly based upon experiment. His biographer, Dr. Henry, is led to conclude that "the discovery of the law of multiple proportions was, in the order of mental operations, the immediate *antecedent* of the atomic theory of chemical combination." Richter, between 1789 and 1802, constructed a table of reciprocal proportions, and Dalton is said to have acknowledged that this suggested to him the speculations which led to the atomic hypothesis. This has been denied; but, in any case, Richter's law preceded the hypothesis.

It is instructive to note the views of two such thinkers as Davy and Faraday on this question. In Thompson's "History of Chemistry," it is stated that Thompson first, and then Thompson and Wollaston together, tried in vain to induce Davy to accept the hypothesis, but that Davies Gilbert afterwards succeeded. Yet in 1811 Davy writes:—"It is not on any speculation upon the ultimate particles of matter that the true theory of definite proportions must ultimately rest;" and in his works he refused to employ the term "atom," preferring "proportion."

In 1853, Faraday writes:—"As to the little solid particles which are by some supposed to exist independent of the forces of matter . . . as I cannot form any idea of them apart from the forces, so I neither admit nor deny them. They do not afford me the least help in my endeavour to form an idea of a particle of matter. On the contrary, they greatly embarrass me." "The notion of a solid nucleus without properties . . . becomes to me hypothetical, and what is more, a very clumsy hypothesis."

In the same year, Liebig, while supporting the atomic hypothesis, said:—"Dalton's atomic theory was a product of the age, and sprang forth in his mind, as a *consequence* of the discovery of chemical proportions or equivalents."

The rapid advance of chemistry where the atomic hypothesis is accepted would furnish a valid argument in its favour, but that, as I believe it is due not to the hypothesis at all, but to the application of the several laws of combination and the use of symbols, all which are susceptible of proof quite independently of the hypothesis.

I should like to say a little about the question of isomerism, but, in view of the length of this letter, will content myself with remarking that it appears to me that the explanation offered by the atomic hypothesis involves three assumptions—first, that matter is ultimately composed of atoms; second, that in isomeric bodies the constituent atoms are differently arranged; and third, that this difference of arrangement is the cause of the observed difference of physical properties. As far as I know, saying nothing of the first of these assumptions, no evidence whatever has been brought forward in support of the second and third. The so-called explanation is about as real as that which accounts for the action of manganese dioxide in reducing the temperature of decomposition of potassium chlorate, by saying that it is catalytic.

Apologising for so great a trespass on your space,—
I am, &c.,

William Thorp, jun.

June 19, 1872.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, June 3, 1872.

This number opens with a short account of the mission which M. de Quatrefages and E. Becquerel have performed as representatives of the Academy, at the centenary celebration of the Royal Belgian Academy of Sciences, recently held at Brussels. It appears that the French delegates are highly pleased with their reception, and intend to give a more detailed account of the proceedings at which they have assisted.

The following papers relating more particularly to chemistry are published in this number:—

Formation of Acetylen by Means of Electric Discharges not attended with Sparks (Décharge Obscure).—Dr. Berthelot.—After first referring to the modes of formation of acetylen in general, the author states that he also obtained this body by applying Houzeau's apparatus for making ozone, passing the electric current through hydrogen saturated with vapours of hydrocarbons; but the quantity of acetylen thus formed is very small, and the author ascribes this to the fact that the electric discharge attended with sparks has a far higher temperature than the dark (non-luminous) discharge, and that, while acetylen is not decomposed by a high temperature, ozone cannot be formed under the latter condition.

Conversion of Ethyl-Naphthalin into Acenaphthen.—Drs. Berthelot and Bardy.—Ethyl-naphthalin is a complex hydrocarbon, discovered by Drs. Fittig and Remsen, by means of the reaction of bromated naphthalin, hydriodic ether, and sodium. Ethyl-naphthalin, $C_4H_4.C_{20}H_8$, differs from acenaphthen in having two equivalents more of hydrogen, the formula of acenaphthen being $C_4H_2.C_{20}H_8$. This last-named body was first discovered by the authors, having been prepared by causing ethylen or acetylen to react at red heat upon naphthalin; acenaphthen occurs ready formed in coal-tar. The methods of conversion of ethyl-naphthalin into acenaphthen are described by the authors at length: one of these methods consists in passing ethyl-naphthalin through a red-hot tube, this decomposition being elucidated by the formula—

$$C_4H_4.C_{20}H_8 = C_4H_2.C_{20}H_8 + H_2.$$

Another method is by the wet way—treatment with bromine and alcoholic potassa solution, at a higher temperature: this reaction—which, however, yields only a very small quantity of acenaphthen—is elucidated by the following formula:—

$$C_4H_3Br.C_{20}H_8 + KHO_2 = C_4H_2.C_{20}H_8 + KBr + H_2O_2.$$

Ethyl-benzine has been by the authors converted, by the last-mentioned method, into styrolen.

Although not strictly belonging to chemical subjects, we quote the titles of the two following memoirs:—

Observations on Chlorosis and Anemy as affecting Men and Women, a Communication made in consequence of Boussingault's Memoir on the Iron contained in Blood and Food.—Dr. Bouillaud.—A very important physiologico-pathological paper.

Note on the Distribution of the Water of the River Rhone, at Nimes.—A. Dumont.—This memoir contains a condensed description of an ingenious mode of supplying Nimes with water from the River Rhone, which water is naturally filtered (*filtration naturelle*), while passing through the subterranean aqueduct, the largest now known to exist. This city, it should be remembered, was in ancient times copiously and magnificently provided with pure water by the aqueduct—now partly in ruins—known as the *Pont du Gard*, and destroyed by the Vandals.

La Revue Scientifique de la France et de l'Etranger, June 15, 1872.

This number contains no papers relating to chemistry.

On Animal Heat.—Dr. C. Bernard.—These excellent lectures are continued, and deserve attention. This portion, which is illustrated with woodcuts, treats on the influence of the nervous system, and more particularly the sympathetic system upon circulation, and collaterally upon animal heat.

Bulletin de la Societe Chimique de Paris, Vol. 17, No. 4, February 15, 1872.

From the *procès-verbaux* of the meeting of this Society referred to in this number, we quote the following particulars:—

Chlorides of Sulphur.—M. Maumené.—The author states that he has obtained by the action of chlorine upon sulphide of carbon, two peculiar chlorides, viz., (1), $CSCl_2$, boiling at 47°; (2), CSCl, boiling at 70°. Dr. Guignet observes that sulphide of carbon is very readily acted upon by chlorine, even when the latter is left in contact with the former in the state of solution, as chloride of carbon and chloride of sulphur are then formed. When vapours of sulphide of carbon and chlorine are passed through a red-hot tube, tetrachloride of carbon is abundantly formed; the same obtains when sulphide of carbon is treated with perchloride of antimony, in which case a smaller quantity of by-products are obtained.

The following original memoirs are contained in this number:—

Temperature at which the Spontaneous Crystallisation of a Supersaturated Solution of Sulphate of Soda takes place.—L. C. de Coppet.—We regret that the great length of this memoir, and the necessity of reproducing several tabulated formulæ essentially required for the proper understanding of the subject, render it unsuitable for useful abstraction, notwithstanding its high intrinsic merits.

On Sexbasic Saccharate of Lime.—H. Déon.—When tribasic saccharate of lime is treated with alcohol the sexbasic saccharate is obtained by elimination of one-half of the sugar, exactly in the same way as by treatment of the monobasic saccharate with alcohol yields the bibasic saccharate; while the monobasic and tribasic saccharates contain water, the bibasic and sexbasic saccharates contain none. The reactions are thus analogous, and may be expressed by the following formulæ:—$C_{12}H_{11}O_{11}6CaO$, derived from—

$$2(C_{12}H_{11}O_{11}3CaO + HO)C_{12}H_{11}O_{11}2CaO,$$

derived from $2(C_{12}H_{11}O_{11}CaO + HO)$; when sexbasic saccharate is combined with two equivalents of sugar, bibasic saccharate is obtained,—and when two equivalents of sugar are added to tribasic saccharate, monobasic saccharate is formed.

Black Colouring Matter contained in Native Bitumen.—MM. Le Bel and A. Muntz.—The authors have extracted from bitumen (native, as well as that obtained from tar) a black-coloured substance, insoluble in alcohol and ether, soluble in sulphide of carbon and chloroform, and fusing—without volatilising—at between 130° and 145°. This substance, which possesses very great colouring power, has been called asphaltene, and was found to consist chiefly of carbon and hydrogen. From an Egyptian bitumen the authors also obtained a similar body, but this was found to contain more oxygen, and, moreover, a notably large proportion of ash.

No. 5, March 1, 1872.

This number contains the following original papers and memoirs :—

Acetic Ethers of Dulcite and Dulcitan.—G. Bouchardat.—The following compounds are described :—Diacetic dulcite—

$$C_{12}H_2(H_2O_2)_4(C_4H_4O_4)_2,$$

a solid crystalline body, soluble in water, nearly insoluble in alcohol and in ether, fuses at 175°, is partly decomposed by boiling water, also by alkaline solutions; hexacetic dulcite, $C_{12}H_2(C_4H_4O_4)_6$, also a solid crystalline compound, fusing at 171°, sublimable at 250° in an atmosphere of carbonic acid, nearly insoluble in cold water and in cold alcohol and ether,—hot water and weak alkaline solutions decompose this compound; pentaceto-monochlorhydric-dulcite—

$$C_{12}H_2(C_4H_4O_4)_5HCl,$$

is a solid crystalline compound, almost insoluble in all neutral solvents, while at the boiling-point of the same the compound is decomposed into pentacetic dulcite and hydrochloric acid,—boiling acetic acid converts it into hexacetic dulcite; pentacetic dulcite—

$$C_{12}H_2(H_2O_2)(C_4H_4O_4)_5,$$

fuses at 165°, sublimes at 250°; diacetic dulcitan—

$$C_{12}H_4O_2(H_2O_2)_2(C_4H_4O_4)_2,$$

is an amorphous, viscous, bitter-tasted substance, soluble in cold water, alcohol, and ether, and converted into tetracetic dulcitan, at 180°, by anhydrous acetic acid; tetracetic dulcitan—

$$C_{12}H_4O_2(C_4H_4O_4)_4,$$

is an amorphous resin-like substance, insoluble in cold water, very soluble in cold alcohol and ether.

Conversion of Aceton into Hydruret of Hexylen.—G. Bouchardat.—This paper treats on a compound produced by the action of nascent hydrogen upon aceton, viz., $2C_6H_6O_2+H_2=C_{12}H_{14}O_4$, which, according to the author, may be considered as dipropyl or hydruret of hexylen. To prove this a series of experiments have been made, the result of which confirms the author's opinion.

No. 6, March 15, 1872.

This number only contains the following original paper—

Solubility of Oxides in Alkalies.—M. Prud'Homme.—The main gist of this short notice is, that the addition of a small quantity of a salt of copper to a liquid containing a precipitate of sesquioxide of chromium (produced by ammonia in excess) re-dissolves that precipitate, which, however, reappears on boiling the liquid; inversely, oxide of copper is dissolved in potassa, in the presence of a salt of chromium, but at a higher temperature (above 100°) the oxide of copper is precipitated.

No. 7, April 1, 1872.

This number contains the following original papers and essays :—

Industrial Manufacture of Chlorine.—F. de Lalande and M. Prud'Homme.—Reserved for full translation.

On some Facts of Incomplete Oxidation as observed to take place in the Human Organism.—G. Daremberg.—The author relates, at length, a series of chemico-pathological researches, from which it appears that, in heart and lung diseases, the urea secretion decreases and that of uric acid increases.

On Ammoniacal Platinum Bases.—P. F. Cleve.—The fourth instalment of a lengthy monograph on this subject, this part being divided into the following sections :—Derivatives of platosemidiamine which contain aniline; derivatives of platosamine which contain aniline; derivatives of platosemidiamine which contain ethylamine; derivatives of platosamine which contain ethylamine.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 10, 1872.

This number contains the following original papers and memoirs :—

Non-Existence of Parathionic Acid.—C. Scheibler.—Referring to Erlenmeyer's researches, lately published on this subject, the author has proved the non-existence of this acid (first discovered and described by Gerhardt, in his *Traité de Chimie Organique*, as a body isomeric with ethyl-sulphuric acid) as far back as the year 1862, at which period the author made a communication on the subject at the meeting of the German philosophers and *savants*, held at Karlsbad, which communication was duly published in the *Tageblatt* of that meeting, pp. 66 and 80.

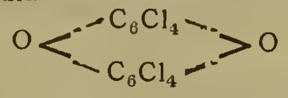
New Method of Synthesis of Diphenylketon.—M. Kollarits and V. Merz.—Benzoic acid and benzol were introduced, with anhydrous phosphoric acid, into a strong glass tube, which, having been sealed, was heated for a considerable time up to 180° to 200°. After treating the contents of the tube first with ligroine then with caustic potassa-solution, and afterwards submitting the oily fluid to fractional distillation, the authors obtained diphenylketon as a beautifully-crystalline body, fusing at about 49° and boiling at 300°, yielding on elementary analysis results which led to the formula $C_{13}H_{10}O$ diphenylketon. In the presence of anhydrous phosphoric acid, benzol behaves with benzoic acid as an alcohol does with acids, the benzol hydrogen being eliminated as an alcoholic hydrogen;

$$C_6H_5.H+C_6H_5.CO.OH=C_6H_5.CO.C_6H_5+H_2O;$$

the authors take, for this method of preparation of diphenylketon, 5 parts of benzoic acid, 6 of benzol, and 8 of anhydrous phosphoric acid, and heat for about five hours.

Researches on the Glycerine Derivatives.—L. Henry.—This exhaustive memoir, treating on the glycid and propargyl compounds, is elucidated by lengthy and complex formulæ.

Perchlorphenol.—V. Merz and W. Weith.—After first referring to the researches of Erdmann, Laurent, Schützenberger, and others on this subject, the authors describe the method of preparation of per- or penta-chlorphenol by treating with chlorine gas a mixture of 3 parts of phenol and 1 of chloride of antimony placed in a suitably-constructed vessel in a water-bath. After a somewhat tedious process of purification, there is obtained perchlorphenol, a solid crystalline substance soluble in ether and alcohol. These solutions exhibit acid reaction to test-paper. Perchorphenol fuses at from 186° to 187°, and may be sublimed; potassium-perchlorphenylate, C_6Cl_5OK, obtained by treating perchlorphenol with potassa, is soluble in a mixture of ether and alcohol, crystalline, contains 12·87 per cent of potassium. The authors further describe at length the action of nascent hydrogen, of concentrated nitric acid (which, at the ordinary temperature, converts perchlorphenol into perchlorchinon), of chloride of phosphorus upon perchlorphenol. When the above-mentioned potassium salt is submitted to a high temperature, there is formed perchlorphenyl oxide, C_6Cl_4O, molecular formula—



$$O\begin{matrix} \diagup C_6Cl_4 \diagdown \\ \diagdown C_6Cl_4 \diagup \end{matrix}O$$

Its mode of formation from potassium-perchlorphenylate is elucidated by the following formula—$C_6Cl_5.OK=KCl+C_6Cl_4O$.

Physical Feasibility (Physikalische Mœglichkeit) of the most Recent Hypothesis Set Forth by Kekulé Concerning Benzol.—A. Michaelis.—This algebraico-physical essay is, notwithstanding its scientific value, not well suited for abstraction.

Monochlorcrotonic Acid Obtained from Croton-chloral.—C. Sarnow.—This monograph is divided into the following sections :—introduction, treating on the acid ($C_4H_4O_2$) obtained by Geuther from monochlor-tetracylic acid; monoclor-crotonic acid and its salts; monochlor-crotonitrile (C_4H_4ClN); monochlorbrom-butyric acid ($C_4H_5ClBr_2O_2$) and its salts.

On Some Pigments Derived from the Aromatic Azodiamines.—Dr. A. W. Hofmann and A. Geyger.—The first instalment of a lengthy monograph on this subject, this part treating on azodiphenyl blue.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, April 18, 1872.

Description of a Newly-invented Press for Extracting the Juice from Beet-root Pulp.—M. Camponnois.—This contrivance, illustrated by a woodcut, appears to be in every respect superior to the machinery now in use for this purpose.

Atmismometer.—M. Piche.—The description of an instrument invented by the author, and destined to measure the degree of evaporation and its rapidity; it is therefore a complement to the psychometer.

Glass-made Plummer-Blocks and Axle-Bearings.—MM. De Camus and Haret.—From what is stated here, it would appear that glass is successfully substituted by the authors for bronze, in the pieces of machinery just mentioned. The use of glass for the purpose alluded to seems to be attended with many advantages, and among these that of requiring less labour in making the articles, and greatly decreased consumption of lubricating material.

Les Mondes, June 13, 1872.

Inspector-General of Meteorological Stations in France.—Dr. Charles Sainte-Claire Deville has been appointed to the post just named.

Petites Annales de Chimie.—Dr. Maumené.—Under this title the author continues to expound his views on theoretical chemistry. This memoir is illustrated by a series of formulæ.

Laws relating to the Solubility of Salts and the Elementary Gases in Water.—D. Tommasi.—The author states that for salts having the same chemical formula (sulphates, bromides), the co-efficients of solubility in water are in direct relation to their specific heat. This is illustrated by a series of examples exhibited in tabulated forms. As regards the elementary gases (chlorine, oxygen, &c.), their solubility in water is in the inverse ratio of their specific heat.

June 20, 1872.

Catalogue of Raw Materials.—M. Bernardin.—The author has published, first, a descriptive catalogue of all the oils, next, of all the textile fibres, and recently, of all tanning materials, and is now occupied with a similar work on woods. According to the brief account here given of these works, they are highly valuable to industry and commerce.

Cause of the Spectrum Rays.—A. Cauchy.—This paper contains an account of the cause of the spectrum rays, as explained by the undulation theory of light.

Modification of the Electric Machine.—L. Brunelli.—This paper treats on the improvements made by A. Kundt in the instrument alluded to.

A Lightning-Conductor Destroyed by Lightning.—M. Désiré.—An account of an occurrence in Belgium; a lightning-rod was completely demolished, and great damage done to the building it was intended to protect.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 234, June, 1872.

This number contains no original papers relating to chemistry.

NOTES AND QUERIES.

Iodine.—(Reply to J. S.).—You will have to make a full analysis of the material. Consult Fresenius, or, for volumetrical methods, the latest edition of Mr. Sutton's excellent work lately advertised in the Chemical News.—A.

Salts of Chromium.—(Reply to "Chromium").—As laboratory specimens, yes; commercially it would be difficult, not however impossible, but would add to the cost of the material; practically the commercial products are pure enough for use.—X.

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P. M.—(1). Study Miller's work on Chemistry, published by Longmans and Co. (2). It entirely depends upon the size of the works, the knowledge and skill required, &c.

G. W.—Consult Watts's "Dictionary of Chemistry" and Fresenius's "Quantitative Analysis."

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INDEX.

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